The Mining Magazine

Edited by T. A. RICKARD.

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EXPLANATORY NOTE.—Items in italics are names of books reviewed; illustrated articles are denoted by Asterisks (*); the letters (*c.l.*) refer to notices of articles under the heading 'Current Literature'; the letters (*p.t.*) to abstracts appearing in 'Précis of Technology.'

The Mining Magazine

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Managing Director.

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CONTENTS.

STATISTICS

Stocks of Copper in England and the Continent
Reported by Henry R. Merton & Co. Tons of 2240 lb.

	Oct. 31 Tons	Nov. 30 Tons	Dec. 31 Tons
In England	13,278	11,993	11,598
In France	2,972	2,487	3,192
Afloat from Chile	1,350	2,050	2,300
Afloat from Australia	3,750	4,950	4,000
In Rotterdam	2,400	2,500	3,750
In Hamburg	1,079	1,785	3,594
In Bremen	998	992	1,176
In other European Ports	1,550	1,030	1,050
Total European visible supply	27,377	27,787	30,570

American Copper Producers' Association's Figures.
In Tons of 2240 lb.

	Production.	Deliveries			Stocks at end of month
		Domestic	Foreign	Total	
Total, 1911	639,258	316,791	337,009	653,800	—
Total, 1912	706,052	365,920	333,212	699,132	—
January	64,053	29,111	26,956	56,067	55,000
February	58,460	26,641	32,219	58,860	54,600
March	60,822	34,190	34,682	68,872	46,550
April	60,416	34,892	38,346	73,238	33,728
May	63,088	36,209	30,477	66,686	30,130
June	54,402	30,559	30,396	60,955	23,577
July	61,640	26,296	35,035	61,331	23,886
August	58,764	32,897	32,706	65,603	17,064
September	58,661	29,837	32,627	62,464	13,261
October	62,085	30,435	30,412	60,847	14,499
November	59,860	1,721	31,280	53,001	21,358
December	62,049	9,794	32,831	42,625	40,782
Total 1913	724,307	342,566	387,974	730,540	—

Production of Gold in the Transvaal.

	Rand	Elsewhere	Total	Value
	Oz.	Oz.	Oz.	£
Year 1912	8,753,563	370,731	9,124,299	38,757,560
January 1913	760,981	28,409	789,390	3,353,116
February	702,394	31,728	734,122	3,118,352
March	760,324	30,228	790,552	3,358,050
April	755,858	29,116	784,974	3,334,358
May	761,349	32,957	794,306	3,373,998
June	716,267	30,810	747,077	3,173,382
July	625,107	30,282	655,389	2,783,917
August	697,686	30,410	728,096	3,092,754
September	676,411	29,775	706,186	2,999,686
October	687,515	30,916	718,431	3,051,701
November	644,320	29,166	673,486	2,860,788
December	642,786	30,029	672,815	2,857,938
Year 1913	8,430,998	363,826	8,794,824	37,358,040

Cost and Profit on the Rand.

	Tons	Yield per ton	Cost per ton	Profit per ton	Total profit
		s. d.	s. d.	s. d.	£
Year 1912	25,486,361	29 2	19 3	9 11	12,678,095
January 1913	2,296,948	27 8	18 0	9 9	1,113,579
February	2,100,137	27 11	18 3	9 9	1,019,774
March	2,321,254	27 5	17 8	9 8	1,121,786
April	2,301,099	27 6	17 11	9 7	1,101,099
May	2,366,726	26 11	17 7	9 4	1,099,397
June	2,177,354	27 6	17 8	9 9	1,061,507
July	1,873,980	27 6	19 4	8 3	785,263
August	2,162,807	27 1	17 7	9 6	1,026,851
September	2,035,318	27 9	17 10	9 10	1,002,228
October	2,073,909	27 6	17 9	9 8	996,515
November	1,955,573	27 6	17 11	9 7	931,145

Gold Output of India.

Year 1911	Year 1912	Dec. 1913	Year 1913
£2,150,050	£2,265,094	£201,931	£2,299,315

Natives Employed in the Transvaal Mines.

	Gold mines	Coal mines	Diamond mines	Total
January 31, 1913	200,090	8,789	13,912	222,791
February 28,	207,662	8,877	13,918	230,457
March 31	207,733	9,009	15,041	231,783
April 30	205,424	9,053	15,626	230,103
May 31	197,644	9,062	15,345	222,051
June 30	188,094	9,060	14,654	211,808
July 31	170,242	9,403	13,378	193,023
August 31	158,223	9,236	13,172	180,631
September 30	152,637	9,361	12,321	174,319
October 31	148,882	9,377	12,712	170,971
November 30	147,569	9,286	12,680	169,535
December 31	150,012	9,516	11,811	171,339

Production of Gold in Rhodesia.

Year 1910 £	Year 1911 £	Year 1912 £	Nov. 1913 £	Year 1913 £
2,568,201	2,647,894	2,707,368	239,036	2,648,542

Production of Gold in West Africa.

Year 1911 £	Year 1912 £	Nov. 1913 £	Year 1913 £
1,069,442	1,497,179	132,694	1,507 228

Production of Gold in Western Australia.

	Export oz.	Mint oz.	Total oz.	Total value £
Total, 1910	363,496	1,209,856	1,573,352	6,682,042
Total, 1911	160,021	1,210,447	1,370,468	5,823,522
Total, 1912	83,589	1,199,080	1,282,669	5,449,057
January to Oct., 1913	73,549	1,010,562	1,084,111	4,606,139
November	9,582	108,330	117,912	500,855
December	3,124	108,996	112,120	476,253
Total 1913	86,255	1,227,888	1,314,143	5,448,332

Other Australasian Gold Production.

	1911	1912	Dec. 1913	1913 to date
		£	£	
Victoria	2,138,000	2,039,400	171,200	1,847,400
Queensland	1,623,390	1,484,160	88,810*	1,023,440*
New South Wales	769,353	702,129	53,849*	577,789*
New Zealand	1,808,049	1,345,115	218,411	1,345,131

*November figures only.

Nigerian Tin Production.
In tons of concentrate of unspecified content.

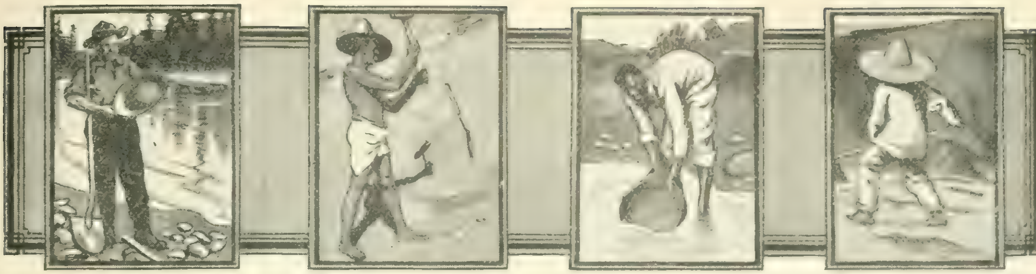
Year 1912 tons	Oct. 1913 tons	Nov. 1913 tons	1913 to date tons
2,532	480	446	4554

Sale of Tin Concentrate at Redruth Ticketings.

	Tons	Value	Average
Year 1911	6151¼	£702,599	£114 4 5
Year 1912	6492	£831,908	£128 5 6
January to October, 1913	5228¼	£647,970	£123 17 6
November 10	250	£25,595	£102 7 7
November 24	248½	£25,827	£103 18 8
December 8	228¾	£22,605	£98 16 5
December 22	230½	£22,271	£96 12 6
Year 1913	6186	£744,268	£120 2 6

Exports of Tin and Ore from Straits and Bolivia.
Reported by A. Strauss & Co.

	1912 tons	Dec. 1913 tons	1913 tons
Metal from Straits to Europe and America	59,036	5,205	62,533
Metallic Content from Bolivia to Europe	21,149	2,125	24,843



REVIEW · OF · MINING

INTRODUCTORY. — The mining market shows a better undertone, with occasional spasms of animation. Mexican conditions are still a threatening factor, but we are becoming inured to them. On the Rand the threat of a general strike has been translated into action, but it looks as if the agitators will suffer defeat, and in that case a danger long imminent will have been removed for good. The strong price of lead is helping Broken Hill and base-metal mining generally. Another factor favourable to the metal market is the suspension of work at most of the big copper and lead smelting plants in Mexico. The American copper statistics for December are disappointing, but we regard the increase in stocks as temporary. The Lake Superior strike still hinders production in that important copper region. The spurt in Anglo-Russian mining shares is interesting, and presages a further expansion of activity in that department.

TRANSVAAL.—The output of gold in the last month of 1913 was 642,786 ounces, valued at £2,857,938. This was a slight decrease as compared with November. Thus the grand total for 1913 is 8,794,824 ounces, worth £37,358,040, which is a decrease of £1,399,520 as against 1912. This is better than at one time seemed probable, for the strike in June and July not only affected the output in those months but disorganized the native labour in various ways. As regards labour, the number of natives employed at the end of December was 150,012, or 2443 more than in November. A year previous the supply numbered 191,316, so that the net loss is 41,304 in the 12 months.

The railway strike is in a critical stage at the time of writing. On January 10 the manager of the Government railways expressed confidence in his ability to keep the mines supplied with coal, and so far the white workers on the mines have not laid down their tools.

On January 10 the Basutos employed at the Jagersfontein diamond mine, near Fauresmith, in the Orange Province, broke into revolt and attempted to rush the white staff. They were overcome after 11 had been killed and 36 wounded. Twelve whites were injured. The outbreak was due to the death of a Basuto, who had been kicked, it is alleged, by a white man.

According to the statistics available, the total dividends paid by the mining companies of the Rand in 1913 was £8,194,096, which is an increase of £241,102 over 1912. Two new names appear on the list, the Consolidated Langlaagte and Van Ryn Deep, together contributing £184,767, while five names disappear, causing a loss of £241,247 in the total. Besides the two new dividend-paying companies, the Meyer & Charlton, Modder B, Van Ryn, Witwatersrand, and Witwatersrand Deep have had a good year. Outside the Rand, the Transvaal Mining Estates, operating at Lydenburg, has increased its dividends from 30 to 40% for the financial year.

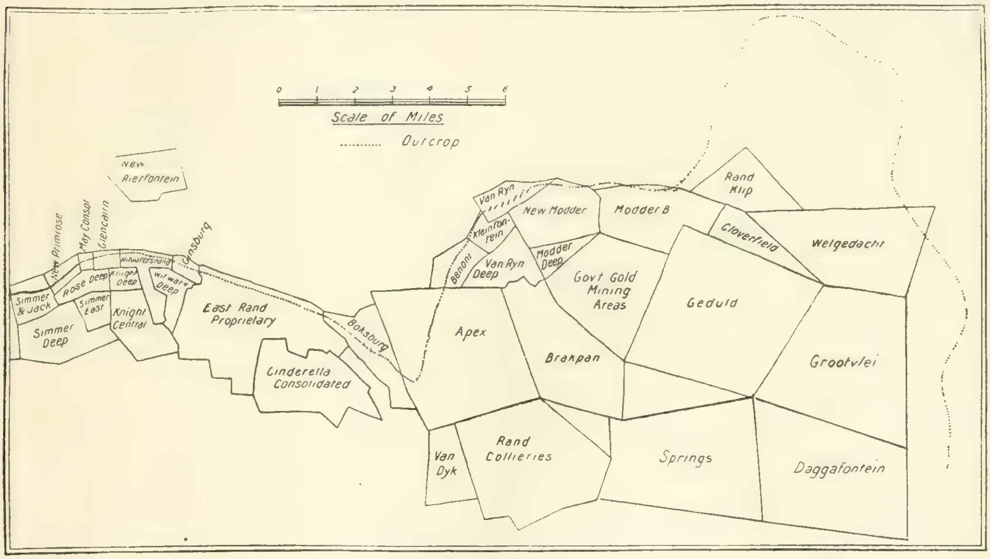
The absorption of the Robinson by the Crown Mines is an important event, on account of the property involved and the nominal extinction of one of the great gold mines of the world. The Robinson sells its assets, except 40,000 Crown Mines shares, to the Crown Mines for 180,000 Crown Mines shares. Some protests have been made by Robinson shareholders against this deal, which has been arranged by the Central Mining group, the controlling factor in the administration of both mines. The Robinson has £425,000 in cash, and about one year's supply of the high-grade ore, equivalent to dividends of £750,000. The Crown Mines has a life of about 30 years with anticipated dividends of £1,000,000 per annum. It has been suggested that the controlling group should have arranged for the Robinson to acquire some of the claims belonging to the Crown Mines, and so prolong its life in the interest of its shareholders. Mr. Louis Reyersbach, speaking for the administration, has stated that the deal was made on the suggestion of several influential shareholders in the Robinson company. He also explained that one of the objects was to perpetuate the interest of the Robinson shareholders in the Rand mining industry and to provide for the amortization of the Crown Mines debentures. Under the scheme the profit accruing from the Robinson to the Crown Mines in excess of the dividend payable on the 180,000 shares, issued to the Robinson shareholders, will be set aside to redeem those debentures. In the opinion of the experts who appraised the two properties, the Crown Mines is estimated to be depreciated by the current market quotation more severely than the Robinson, so that comparisons made on the basis of present quotations are misleading. Nevertheless, the minority Robinson shareholder feels restive, especially as it is generally understood that the controlling house is a small holder of Robinson shares, while it holds, through the Rand Mines, no less than 800,000 Crown Mines, but this restiveness is due, we believe, to a misapprehension of the final productiveness of the Robinson mine.

The Van Ryn Deep and the Consolidated Langlaagte paid maiden dividends of 1s. 6d. and 2s., respectively, in December. Indeed, the Barnato group is doing well and is likely to occupy an increasingly commanding position as its deep-level holdings come to fruition. The Randfontein Deep, for example, dominates the extension of the Randfontein consolidation. In the diamond market, the firm of Barnato Bros. is, of course, a powerful factor, and has prospered exceedingly during late years. We are informed, from detached sources, that the technical work done by this group is excellent; how much of the credit is due to Mr. J. G. Lawn, their chief consulting engineer, we do not know, but we believe that it is only fair to mention his name in this connection.

The past year was peculiarly hard on the Brakpan because it came on the heels of extraordinary good luck in the year preceding. Unduly good returns during part of 1912 were caused by the need for working stopes that were not only richer than the average but also wider, for fear that a settlement of the hanging wall might hinder future extraction. This hope was not fulfilled, and meanwhile shortage of labour and poor development caused the effort to seem particularly unfortunate, in so far as it may have proved confusing. Since then the necessity for expediting development, with labour shortage, has caused an undue proportion of low-grade ore to be milled. Evidently the stope subsidence proved more serious than was at first anticipated, and since then work has had to be diverted largely to the low-grade stopes that are more easily worked. The average assay-value of the ore developed during the latter months of 1913 is but little inferior to the average of the mine as a whole, and better than the averages in 1909 and 1910.

The amalgamation of the Apex, Benoni, and Kleinfontein properties has hung fire for more than a year. An intimation of negotiations for an amalgamation of the Apex and Benoni was made in July, 1912. Late in 1913 the Kleinfontein began to receive mention as a third party to the deal. On December 22 the satisfactory conclusion of negotiations between the three companies was finally announced. Thus the New Kleinfontein acquires the mining property of the two other companies, in exchange for blocks of shares, thereby lengthening its life at the expense of fresh obligations in the matter of development and plant.

due to the shorter month. For the 11 months of 1913 the total production is £154,431 more than for the same period of 1912. Among individual outputs in November, the Abbontiakoon made a decided increase, of £4100, due to the crushing of higher-grade ore. The Abosso and Prestea each made decreases equal to the Abbontiakoon's gain, in both cases due to the crushing of a smaller tonnage of ore. At the Abosso the yield per ton also diminished. The Broomassie made a small gain, due to improvement in grade.



THE EASTERN RAND.

In declaring their December dividend, the directors of the Randfontein companies stated that their supply of native labour did not reach 70% of the complement required to operate at full capacity, but they express a hope of improvement in this regard.

We note that complaint comes from the natives that after they have become trained to their work underground, they are not paid according to their increased capacity. This is doubtless due to pressure from the white supervisors, whose superiority is challenged.

WEST AFRICA.—The November output of gold was normal, the small decrease being

RHODESIA.—The output of gold in November showed a decrease of £8032 as compared with October, but an increase of £13,079 as against the preceding November. Among individual changes we note a drop in the yield from the Eldorado, Giant, and Lonely Reef.

The board of the Globe & Phœnix has reduced the quarterly dividend from 1s. 9d. to 1s. per share, in order to provide for capital expenditure. This is a wise and necessary step, in accord with the urgent suggestion made by Mr. H. H. Haldinstein at the annual meeting.

CANADA.—The Granville company, operating in the Yukon, handled 6,363,000 cubic yards during the past season, for a yield of 85,899 oz. gold having a value of $1,331,000, equal to 21 cents per yard. The working profit is $851,000, and the cost $480,000. Therefore, the working cost was 7½ c. per yard, as against the estimated cost of 6 c. per yard when operating on full scale. In a season of 240 days Mr. J. W. Boyle, the manager, expects to dig 7,500,000 yards, using three 16-cu. ft. dredges, and one of 7½-cu. ft. capacity. The company's claims cover 122,000,000 cubic yards of gravel, containing $27,500,000 in gold, as ascertained by 850 drill-holes. The same company owns two-thirds of the shares of the North-West Corporation, which controls 600,000,000 cubic yards, of which 100,000,000 are stated by Mr. A. N. C. Treadgold to contain 30 cents per yard, while the other 200,000,000 contain 20 c. per yard, all of which is to be exploited at a cost of 10 c. per cubic yard. In 1915 it is expected that the North-West Corporation will be handling 7,000,000 yards per season. These figures are striking, and give promise of gold-mining operations on a handsome scale. As Messrs. Boyle and Treadgold are vendors, it would be well if these estimates were checked by an independent engineer. We do not make this suggestion in a captious spirit, but suggest it as a precaution on behalf of the minority shareholders. The sun-thawing method (described in our issue of November 1912) is yet on trial, and it may be that recent results have come from the creek-bed where the gravel is not frozen. The query persists as to what depth sun-thawing is efficacious. We shall be glad to publish any technical contribution on these matters.

The Yukon Gold and the Canadian Klondyke mining companies appear to find their close neighbourhood a source of annoyance. The former applied recently for an injunction restraining the latter from continuing to operate its No. 4 dredge, it being claimed that such operations impeded the river-channel so as to jeopardize ground on which the Yukon Gold had erected buildings and plant in connection with its own dredging operations. The injunction was denied, but a suit is pending.

Kirkland Lake Proprietary shares have gone to nearly double their par value on rumours of the impending flotation of the Tough Oakes mine, on which this company has an option. Among others, Mr. H. H. Johnson, formerly of the Village Deep, has expressed a high opinion of the mine. The ore is extremely rich; we would like to see the shaft sunk rapidly.

It is estimated that in 1913 the mines of Cobalt produced 30,000,000 ounces of silver, worth $18,000,000. On the other hand, Porcupine is credited with $4,250,000 in gold, of which the Hollinger contributed $2,600,000, the Dome $1,080,000, the Porcupine Crown $300,000, and the McIntyre $200,000.

AUSTRALASIA. — Our Melbourne correspondent reviews the progress of the mining industry during 1913. Labour troubles continue to be a vital factor, as in South Africa and in regions nearer home.

The Zinc Corporation is fortunate in its South Blocks mine, which is developing most satisfactorily. Another orebody has been cut in a bore-hole on the 6th level.

On December 15 a fire at the central power-station of the Mount Morgan company caused a stoppage of operations for a couple of weeks. The output has suffered also by reason of the necessity for treating the low-grade ore broken in the course of extra development and in excavating the site for the new concentrating mill.

Operations at the Talisman were resumed on January 6 after suspension from the early part of November, by reason of the coal strike in New Zealand. At the Waihi also work has been resumed on the 11th level.

The Great Fitzroy company acquired an option on the Laloki mine in Papua or New

Guinea, in order to obtain basic ore for mixing with its own output in Queensland. Developments at the Laloki have been satisfactory, so that 145,000 tons averaging 4% copper and 2 dwt. gold per ton has been proved. The deal was closed at the end of the year.

Our editorial comment on the Great Cobar was written before the poll was declared. The result is as we anticipated. We note, however, that only 68,000 shares were counted. Mr. W. J. Barnett is to be congratulated on heading the poll. Mr. G. E. Baker has resigned from the board.

The Government of Western Australia has withdrawn the Mines Regulation Bill, which would have burdened the mining companies with a large amount of needless trouble and inconvenience. Hence the news has been received in London with relief and thankfulness.

INDIA.—The output of gold at the Indian mines during 1913 was worth £2,298,313, as compared with £2,265,094 in 1912, and £2,150,050 in 1911. The growth of the gold production of India has been remarkably regular since the beginning of operations by the English companies in the late 'eighties, the only setback having been in 1907, when the average yield at the Champion Reef mine suddenly fell. At the present time the increase is due partly to the accession of the Anantapur group as producers and partly to the increased extraction from slime by the cyanide process. The current reports from the four mines at Kolar all indicate that at numerous points the lodes are still developing satisfactorily in depth. The trust of shareholders in the future persistence of the lodes is shown by the fact that the market quotations of the shares yield 11 to 14% on the money invested. The speculative element in Indian shares is supplied by the Anantapur mines, the most promising of which is the North.

MEXICO.—Conditions continue much the same. Savage fighting continues, inconclusively. At Tampico the Carranzistas were repulsed; at Ojinaga the Federal troops escaped annihilation by crossing into Texas. The financial position of the Huerta government is becoming steadily more precarious. Meanwhile, it appears that Sir Lionel Carden is to be succeeded as British minister by Mr. C. M. Marling, at present councillor of the embassy at Constantinople. The new minister is said to have distinguished himself by the tact and ability displayed during the critical times in the Near East. This is more than can be said of Sir Lionel, who unfortunately gave excuse for the belief that Great Britain was not affording loyal support to President Wilson's policy.

Owing to the chaotic conditions in Mexico, the directors of the El Oro have been compelled to pass the usual interim dividend. Although actual physical interference with the company's operations is not anticipated, it is possible that suspension of work may become necessary through the failure to obtain supplies. The mine itself is reported to be looking well, with specially good developments in the new Ofir claim.

UNITED STATES.—The strike in the Lake Superior region has not been settled. Our New York correspondent writes on this subject.

The California Exploration Company, operating the Plymouth mine, in Amador county, California, has absorbed the Northern Ontario Exploration Company, organized at the time of the Porcupine boom in 1910. Pending the sinking of the Plymouth shaft it had been decided to stop work on the 2000-ft. level, but this was re-considered and on returning to the face of the bottom level it was found that a slip on the hanging wall had exposed 30 inches of $25 ore in addition to 9 feet of $14 ore previously there. The vertical shaft, which passes through the vein at 1400 feet and is 200 feet in the foot-wall at 1600 feet, is to be sunk as an incline parallel to the vein at a distance of 200 feet. Meanwhile, a 30-stamp mill, with tube-mills, is in course of erection.

The purchase of the San Francisco property adds largely to the Pato enterprise of the Oroville Dredging Company. Returns from the Pato dredge have decreased slightly, owing to trouble caused by clay in the gravel, but they continue to be about twice as high as the estimate on which the ground was acquired. That discrepancy has not yet been explained, but we are making inquiries.

RUSSIA. — This department is having a boom, led by Russo-Asiatic shares, which have risen from $2\frac{3}{4}$ to $4\frac{1}{2}$ since Christmas. Kyshtim, Tanalyk, Sissert, Russian Mining, and some of the weaker issues have been advanced in sympathy. The Russo-Asiatic Corporation was registered in April, 1912, and is controlled by Messrs. Leslie Urquhart and H. C. Hoover, with whom are associated two banks at St. Petersburg. In May last we mentioned that the company had acquired, *inter alia*, an option on some valuable silver-lead-zinc deposits in Southern Siberia. This option, after examination by Mr. D. P. Mitchell, has been exercised, and promises to be a fine thing. We believe that the property is the Riddersk, in the Altai region; it is an ancient mine that was worked for the Crown in 1848. Other good options have been obtained in the Nerchinsk district. Information is lacking, not without reason. Delicate negotiations are pending, and any premature statements are likely to be prejudicial to the company's business. That is why, we are informed, the official circular was indefinite. None of the other Anglo-Russian companies are interested in the business pending, although some of them appear to have profited in public esteem on the supposition that they were participating.

The Lena Goldfields, Limited, being a British holding company for a majority interest in a Russian company, the Lenskoie, which operates the alluvial mines in the Bodaibo district, is not able to control the technical operations as much as might be desired. Hence sundry anomalies, accurately reflected in the preposterous cost per cubic yard. The report issued to the English shareholders is a turgid document, full of Russian weights and measures, the objectionable use of which is scarcely mitigated by the tables appended by the consulting engineer, Mr. C. M. Rolker. It looks as if the intention were not to give information clearly, but allowance must be made for the difficulties of the position. Until recently the general manager, Mr. Belozeroff, drew a royalty on the output of gold; this is an arrangement offering a premium on gross production as against net profit. He is no longer manager, we believe, but is suing the company for the loss of this perquisite. Such arrangements having been tolerated by the Russian directorate, it is not surprising to learn that unprofitable ground is worked in order to give employment to surplus labour. Nor do we wonder that the cost of the labour disturbances fell so heavily on the company, which is expected to act as a local Providence for the resident population. At the recent meeting, the chairman referred to Mr. Rolker's estimate of £1,389,000 "odd" [We are glad to see the "odd," instead of the meticulous detailed figures of the original report] and stated that this estimate, made in 1907, has been fully confirmed, the property having yielded £1,800,000 since then in profit. Mr. Rolker deserves credit for this forecast, conservative as it proves to have been. Now he estimates a life of four to five years on the existing scale of extraction. The present manager estimates a life of seven years, and Mr. C. W. Purington, who has recently visited the property, has expressed no opinion. By the way, it appears from Lord Harris's remarks that Mr. Rolker has not been to the Lena since 1907; without being hypercritical, we suggest that reports prepared in London after seven years non-inspection are made at long range, and possess only an academic value.

Academic also is the interest of the Consolidated Gold Fields, although Lord Harris lingers as an effective chairman, for their shares were sold at £4, on the first inkling that the mine was on the down grade. They are now at 1¾. But the property is one that could give a good account of itself for many years if it were managed on modern lines and in accord with alluvial practice as developed in Alaska and the Yukon.

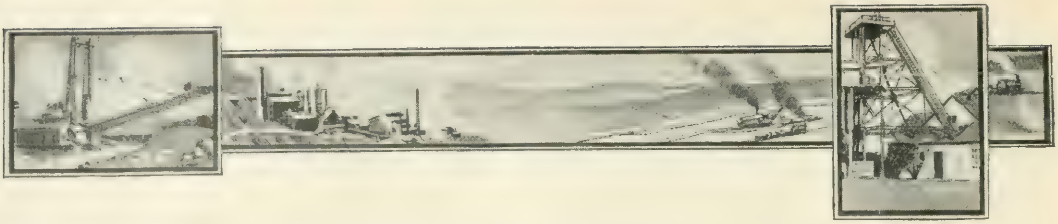
Another report on operations at the Tanalyk has been made by Mr. R. Gilman Brown. It is of highly favourable character. The tonnage of ore in reserve has been increased 33% since September. This is due, in the main, to results obtained in the Mambet mine, where the orebody extends south farther than was anticipated. The average grade, of 94,000 tons, is 2·7% copper, with 7 dwt. gold and 6 oz. silver per ton. The first furnace is expected to start in March, treating 110 to 140 tons of ore daily. The cost is estimated at 34s., to be reduced to 29s. per ton as soon as the second furnace is at work. With copper at £65 per ton, it is expected to make a profit of £2 per ton of ore. Local coal has been tried successfully, so that it is hoped to use it, instead of wood fuel. A narrow-gauge railway is to be built, to connect the various mines and the colliery.

VARIOUS.—A big landslide in the southeast corner of the Tronoh property on December 18 resulted in the loss of 13 lives and the working-face was covered to a depth of 20 feet. The manager cables that at least three months will be required to remove the debris and to reach the tin-bearing ground in this locality. A decrease of 50 tons of tin per month will be inevitable, reducing the normal output of 180 tons to about 130 tons, and augmenting the cost considerably for the current quarter.

A report was circulated that the main shaft of the Pahang Consolidated had collapsed, and it was then rumoured that a new shaft with accessories was being dispatched to the Malay States. Both statements were true, for it was the main shaft in the mill that had gone wrong.

It is stated that ore containing 18 to 30 grammes (10 to 17 dwt. per ton) of platinum per ton has been found in the slate (*tonschiefer*) in the division of Meschede near Remblinghausen in Germany. A company has been registered at Düsseldorf for the exploitation of the platinum deposits in that neighbourhood, and has applied for mining rights for gold and silver, because in Prussia platinum is not subject to concession from the Government, but belongs to the landowner. This application is still pending. Thirteen other applications have been made, but it is hardly probable that many of these will be granted, because the authorities may possibly assume the attitude that there is not sufficient gold and silver present to warrant profitable recovery. As platinum is the property of the landowner it will be necessary to acquire the surface rights before starting operations. Platinum is also reported to have been found in the division of Olpe, which adjoins that of Meschede.

CORNWALL.—The Hobb's Hill property, east of Bodmin, is being re-opened under the direction of Mr. David Draper. The deposit consists of a wide elvan outcropping on the hillside, and it can be worked as a quarry. Sampling, by Mr. Josiah Paull and others, indicates a recovery of 14 lb. black tin per ton. Records show that the property has been worked twice before, on each occasion being shutdown by the low price of tin. The elvan is a hard quartz-porphyry. The cassiterite concentrate obtained is free from objectionable constituents. Nissen stamps and James tables are being erected. The output will be limited to 1000 tons per month at first, until an idea of the future possibilities can be obtained. A waterfall near-by will provide all the power required.



EDITORIAL

WE WELCOME the coming, and speed the departing, year. Most people in London are glad to see the back of 1913, although we say this more out of sympathy than experience, for *The Mining Magazine* has prospered even during the bad times. However, we want to see our friends prosperous, and for that reason look to 1914 to deal kindly with them.

AS we go to press, the South African crisis is culminating, we believe, toward a favourable outcome. The syndicalist revolt is not against the mining companies, but against the State. The Government, representing the State, is proving itself firm and resourceful. Boer and Briton will unite to maintain the law. Civilization must triumph over anarchy.

NEW YEAR'S HONOURS include further recognition of journalism in a peerage to Sir Harold Harmsworth and a knighthood to Mr. Owen Seaman, the editor of *Punch*. Geology is honoured in the bestowal of the Order of Merit upon Sir Archibald Geikie.

IT IS ESTIMATED, by the Director of the Mint, at Washington, that the world's production of gold in 1913 was $455,000,000 or £93,000,000, which is $11,000,000 or £2,260,000 less than the output in 1912. The production of the United States is given as $88,301,023, which is a decrease of $5,000,000 compared with the previous year.

ON January 13 the new home of the Institution, at No. 1, Finsbury Circus, will be opened by the Lord Mayor, supported by the President and Council. Owing to the exigencies of printing, we are unable to give an account of the ceremony in this issue, but we know that the occasion will be memorable.

AMONG other appreciations of the English translation of Agricola's 'De Re Metallica,' we note with pleasure that the gold medal of the Mining and Metallurgical Society of America has been awarded to Mr. and Mrs. H. C. Hoover, the translators.

THE Mr. Rickard who seconded the principal motion at the Metals Extraction Company's annual meeting is a stranger to the office of this Magazine. Nobody in this office holds a share in any mining or metallurgical company.

TRANSPORT is always one of the problems confronting the mining engineer, especially in remote regions. We publish a short, but interesting, article by Mr. F. Close, who, as manager for the Kinandam Sumatra Mining Company, obtained an experience useful to himself and now, by his courtesy, to our readers.

RUSSIAN COPPER shares have risen, mainly on account of the rumoured good options secured by the Russo-Asiatic Corporation. This market activity is due mainly to buying from Russian speculators, who have become optimistic now that the depression caused by the Balkan wars is passing. Similar buying from Russia pushed the Tanalyk shares prematurely a couple of years ago. We understand that the Anglo-American controllers of the Russo-Asiatic do not speculate in the shares of their own companies. This is an important fact, and one we are glad to record.

IN his speech at the Minerals Separation meeting, Mr. John Ballot made a pardonable error in referring to D. Guggenheim & Sons. Mr. Daniel Guggenheim is the oldest of the seven sons of the late Meyer Guggenheim, the founder of the Guggenheim dynasty. He incorporated his business as M. Guggenheim's Sons, giving each of them an interest. It is to Mr. Daniel Guggenheim that the success of the family is chiefly due, but Messrs. Solomon and Simon Guggenheim have played no inconsiderable part. Benjamin Guggenheim went down with the *Titanic*. As a family the Guggenheims have been a big factor in the American base-metal mining industry for two decades.

RECOGNITION of a simple kind of etiquette would simplify the use of the telephone. When two persons are about to speak to each other over the wire, it is obvious that one of them must wait on the convenience of the other. Obviously, also, the one who 'calls up' should do the waiting. In London it appears to be the custom for Mr. Brown, desiring speech with Mr. Green, to tell his clerk to call Mr. Green on the telephone; when the latter answers he is asked by Mr. Brown's clerk if he is Mr. Green, and on an affirmative, he is then requested to wait while Mr. Brown comes to the telephone. This leads to needless waste of time. The person who calls should be the one to wait. This is the rule of the office of *The Mining Magazine*, and we hope it will be accepted as reasonable. When we call on others by means of our egregious telephonic system, we shall be willing to wait the convenience of those whose labours we may have to interrupt.

A CORRESPONDENT writes: "I notice for the first time that Mr. Arthur C. Spencer in his U.S. Geological Survey bulletin on the Juneau Gold Belt (page 91) refers to the 'masses of rock which have been converted into ore or *orey* material.' I regret to see a geologist taking such a privilege with one of the few words held sacred by mining engineers, however clear may be the meaning of the expression in the above context. Being used by a scientist of high standing, the term might find quick favour as an addition to the list of eligible ambiguities for the embellishment of company reports and prospectuses. By way of a change, we would learn that, although the east drift continues to intersect well mineralized ground, the west has now encountered an occurrence of orey material. Anticipating your verdict, I submit the term to your charge for early electrocution in the editorial chair."

Assuredly 'orey' is an ugly interloper; we would spell it awry; it looks like a technical term 'gone scat,' as the Cornish say; it reminds us of Professor Murphy's "highly magleferous matarial, whose chief component pearts were zinc, lead, and tin, with iron pirate and the oxhides of copper."

FINANCIAL ADVICE of sorts is given by sundry papers, and some of it undoubtedly proves helpful to those who wade into the water of diluted securities, or trade on the margin of the speculative whirlpool. Some of it is sublimated piffle. Such we find in *The Sunday Times*, a paper in no way related to the Thunderer. In that hebdomadal journal we find advice tendered on mining shares. The sinister shadow of Sir Abe Bailey used to fall darkly over many paragraphs. Whence the inspiration comes now, we do not know; but it is evidently not a source unimpeachable. The wierdest enterprises are blessed; the queerest obtain commendation. In a recent issue a reference to the Eldorado dividend is made, without any mention of the unpleasant development in depth. The dividend, so says the scribe, confirms what he has "repeatedly said about this mine." That we venture to say, would sound the least prophetic possible. We are told concerning the discovery of a new vein on the Abosso property. To give technical verisimilitude to the insincerities of financial journalism, our Sunday scribe says: "The ilmenite is finely disseminated in the matrix in a high proportion, and the gold is very fine." This sounds like a scientific imprimatur; but it is only twaddle. What price for ilmenite? Why, we know places where the biotite spangles the lode like the stars of a summer night and the gold is so fine as to be invisible.

METALLURGICAL advance has not halted during the past year. Among recent notes of progress we may mention the substitution of disc-grinders in place of rolls in dry crushing, and the use of short tube-mills with steel balls for wet crushing. We may quote an instance in which at Salt Lake one short tube in 24 hours reduced 300 tons of ore from 3-inch diameter to pass a 10-mesh screen. Flotation processes are invading the field of water concentration, and increased attention is being given to them among the big enterprises based on the exploitation of low-grade deposits of disseminated copper. We instance the Inspiration mine, in Arizona, and the Britannia, in British Columbia. Unfortunately, the introduction of this belligerent branch of metallurgy is marked by a trail of bitter litigation. The leaching of ore rich in the basic sulphate of copper, followed by the electrolytic precipitation of the metal, is an interesting feature of the big Guggenheim enterprise at Chuquicamata, in Chile; while at Butte the Laist process is being applied to the beneficiation of the old copper tailing-heaps. In roasting, furnaces provided with air-cooled shafts and arms are displacing water-cooled rabbles where the charge is near the limit of non-fuel roasting. The tonnage of an air-cooled furnace of 18 ft. diameter is 70 to 80 tons per day as against the 45 to 55 tons of the same charge when using water-cooled shafts and arms. In reverberatory practice, oil-firing has superseded coal-firing in all the principal copper-mining districts of the Southwest, it having been demonstrated that a marked gain in capacity, up to 50%, is obtainable. Coal-dust is also being tried as fuel in Montana and Canada, with considerable success. Non-reversible regenerative furnaces fired with producer-gas are being installed in Montana and in Russia. In lead practice the Dwight-Lloyd method of sintering is in general vogue, but this method has not made much headway in copper metallurgy because of the decreased cost of reverberatory work. Here we may mention the Huntington experiments on the sintering of copper carbonate ore at the Bwana M'Kubwa. In the converting of copper matte, the use of basic lining is being brought to a high state of perfection. One converter, for instance, produced 6000 tons of copper with the use of only one lining. The general tendency is for all the larger smelters to make improvements reducing the cost of converting matte to a figure undreamed in the acid-lining practice of former years. The suggested use of the Mackay leaching process at Tanganyika and Bwana M'Kubwa, taken with the work being done at Chuquicamata, suggests the probability that at last the leaching of low-grade oxidized copper ores may be brought to a successful issue, if the disturbing effect of iron salts in the electrolyte can be overcome so as to render precipitation more successful than has hitherto been the case. This, with the wider use of oil-flotation, gives high promise of a far-reaching development in the working of low-grade ores not suitable for direct smelting.

Successful Mining.

During the past year the mining market in London has been disturbed by sundry unpleasant happenings, as is usual in a business so speculative, but the other side of the account has been cheered by several episodes of a highly agreeable character. We take pleasure in recounting some of them.

Three of the oldest and most celebrated mines have given further proof of vitality, namely, the Mount Morgan, Alaska Treadwell, and St. John del Rey. The great gold mine in Queensland was discovered in 1882; in 1889 it yielded 75,000 tons of ore averaging 4 oz. 4 dwt. per ton, giving a gross yield of £1,350,000, and dividends amounting to £1,100,000; the shares rose to £17¼ in 1890, and fell to 1½ in 1892; shortly afterward an orebody of copper sulphide was found under the big cap of silicious gold ore, so that in 1906 this mine became an important copper producer; in May 1913 the holdings of the Hall brothers passed to a syndicate headed by Mr. W. K. D'Arcy and Robinson, Clark & Co., the transfer of control involving the sale of 350,000 shares for £1,250,000. A remodelling of the smelting plant and a re-organization of the whole plan of operations has been put into effect, the net result of which is to place this old bonanza on a new basis of prosperity. Up to December 14, 1913, this great ore deposit has yielded 3,937,050 ounces of gold, worth £16,693,091, and 47,899 tons of copper, worth £2,691,020, allowing the payment of £8,079,166 in dividends.

The Treadwell group of mines on Douglas island, Alaska, presents a striking contrast to the Mount Morgan. Instead of ore carrying ounces of gold, we have here only pennyweights, and not many of them; but in both cases the size of the orebody is superb. The Paris claim was located in 1880, and acquired first by John Treadwell and then by D. O. Mills and others under the name of the Alaska Mill and Mining Co. This company controlled the mine until 1890, when the Alaska Treadwell Gold Mining Co. was organized, with Hamilton Smith as consulting engineer. In 1882 a 5-stamp mill was erected, and by 1890 the plant had been increased to 880 stamps. The first ore came from an open-cut on the outcrop; this became enlarged to a cavernous excavation called the 'glory hole,' out of which 5,086,500 tons of ore have been extracted. In 1895 the first underground stoping was done. To the end of 1912 the total ore mined and milled has been 12,918,732 tons, yielding $31,606,201. The average is only $2·43 per ton, but the cost has been only $1·32, hence the payment of $12,785,000 in dividends. At the present time the ore in reserve is 7,000,000 tons, having an assay-value of $2·50 per ton. The mine is now 1750 feet deep. The orebodies are from 100 to 400 feet wide. Under the same control and management are three other mines operated in the names of the Alaska Mexican and Alaska United companies. In the group are 16,000,000 tons of ore, having an average assay-value of $2·90. This means a tonnage sufficient to supply the five mills for 10 years. During the last three years a comprehensive scheme for obtaining hydro-electric power has been gradually brought to completion, one plant of the kind having reduced the steam-power cost to 14 c., while the second plant is expected to reduce that item of cost to 7 c. per ton, when steam will be used only for hoisting and heating purposes. It is estimated that a total of $1,250,000 will have been expended on obtaining cheap and constant power. A new central shaft for the systematic exploitation of the deeper levels has been started, and will be sunk to 2100 feet before cross-cutting to the lode. It is intended to remove the blacksmith-shop and repair-shop to this level, leaving a solid block of ground 200 feet thick under the 1750-ft. level, so as to protect the mine from caving or water, and also to enable the extraction, by the caving system, of large pillars of ore left standing in the upper workings. In short, the best ideas of modern mining engineering are being applied confidently to this magnificent orebody, by Mr. F. W. Bradley, the president of the company and its consulting engineer, aided by Mr. Robert A. Kinzie, the resident manager.

The St. John del Rey, in Minas Geraes, Brazil, is one of the heroes of mining. This mine has survived two cavings or collapses of its workings, and has continued to grow deeper with unexampled pertinacity. Started in 1834, the upper workings collapsed in 1867, and again in 1886. Two new shafts were started in 1887, and completed in 1892 to the bottom of the mine, then at 2264 feet, in 1895. A cautious policy, due to the flat dip of the lode and the weakness of the hanging wall, has prevented the company from developing the mine on a grand scale; instead, the lower workings consist of a step-like series of levels and shafts, each shaft, 900 feet deep, being 1000 feet farther west than its predecessor, with which it is connected by a main level. The mine is now 7300 feet deep on the dip, and 5200 feet vertically. Since 1835 the total yield has a value of £10,251,500. Since 1895, when Mr. George Chalmers re-opened the mine on a new scheme of development, to the end of 1913, the yield of gold has been 1,596,259 ounces worth £6,784,036, from 2,651,894 long tons of ore. The orebody has averaged 600 feet in length, and 45 feet in width. No marked impoverishment has been evident in the last two thousand feet of sinking, although the orebody is longer and less wide; indeed the St. John del Rey is the rare exception of persistence of ore in depth. The December figures are not yet to hand but the output for 1913 may be estimated at 170,000 long tons, yielding 96,000 ounces, worth £400,000 or 47s. per ton. The total cost, including expenditure on shafts and equipment, is 38s. 4d. per ton. As a provision for the future, and in order to safeguard the prosperity of the enterprise, the company has acquired 140 square miles of land adjoining its gold mine, with a view to exploring for iron ore. This step, taken on the initiative of the manager, Mr. George Chalmers, has already led to the proving of, at least, 160,000,000 tons of ore averaging 67·3% iron and only 0·053% phosphorus. Thus the sagacity and energy that have made the St. John del Rey so long productive will continue to exercise a happy influence on the fortunes of the company.

The biggest new orebody discovered during the year is that of the Burma Mines, in the Northern Shan States, near the Chinese border. The company owning this property was registered in 1906 to smelt some ancient heaps of silver-lead slag in the Burmese highlands. A railway 50 miles long and a smelter were built, but results were not wholly satisfactory. Meanwhile exploratory work was begun amid the abandoned workings from which had come the ore that had enriched the slag. A huge open-cut, 800 feet long and over 350 feet deep, testified to the energy of vanished workers, and in a line with this immense excavation were found other workings, some of them still accessible. During 1913 a drainage adit was advanced under these old workings on a level 171 feet below the bottom of the big open-cut. A length of 950 feet of ore, 44 feet wide, has been disclosed. This assays 25% lead, 25% zinc, and 25 oz. silver per ton. The width is not well defined, the core being rich, and the outside low-grade, but if the orebody were estimated on a Broken Hill basis it would yield startling dimensions. So far it can only be said that this adit—the Chinaman Tunnel, as it is called—has furnished a horizontal section and sample at a depth of 500 feet below the outcrop. At a distance of 2000 feet north from the entrance of this adit there is a shaft only 330 feet deep, as yet ; here three orebodies have been found, giving an aggregate width of fully 30 feet. One of these shows 45 feet of 14% copper ore. These diverse orebodies appear to be in the same ore-channel and will be explored more vigorously as soon as the drainage adit unwaters the ground. In appearance the lead-zinc ore is a metallurgical nightmare ; it looks like poor coke ; it makes the Broken Hill sulphides seem a docile mixture. The ancients—whoever they were—appear to have thought so too. Evidently they avoided the zinc ore, and rejected such as they had to break. Attempts to smelt it are seen in partly fused slag. Similarly, the copper ore was picked and put aside without treatment, although to the modern man it presents no terrors. They did not mine much below water - level, but the remains of old pumps indicate some effort to go deeper. They selected the galena and whatever cerussite there may have been, and reduced it in charcoal furnaces. The country is barren of bushes or trees, and the mountain-sides are bare, probably by reason of the fume from their furnaces and the intensive effort to obtain small wood for making charcoal. The big orebody of the Burma Mines affords today a great problem for the metallurgist ; it can be attacked cheerfully because the ore is wide and rich.

In our next issue we shall record the splendid performances of three or four other famous mines.

Tanganyika Concessions.

The appointment of Mr. Archer E. Wheeler as consulting engineer to the Union Minière du Haut Katanga, controlling the Katanga mines of the Tanganyika Concessions, is an event we are glad to chronicle. Mr. Wheeler has been superintendent of the big smelting plant at Great Falls, Montana, and takes with him to Africa a fine reputation for ability and character. It is exactly four years since we wrote a severe criticism on the Tanganyika Concessions, and we take no particular pleasure in realizing that that criticism has been amply justified. The copper deposits are big, the foundations for a fine business are there, but the efforts to bring the enterprise to fruition have been painfully delayed by a supercilious ignoring of sundry obvious difficulties on the part of metallurgists not equipped to grasp the magnitude of the problem. A proper smelting mixture, a supply of cheap fuel, and favourable rates of transport are among the essentials that were lacking at that time. The plant erected on the Lubumbashi river, near Elisabethville, proves to have been badly placed and badly designed. One of the first things Mr. Wheeler will have to do is to study the local conditions and build a new plant, probably not far from the Kambove ore deposits, which are among the largest and richest on the concession. No supply of sulphide ore has been found, to simplify the smelting. The deposits consist essentially of oxidized ore in a silicious dolomitic gangue. For a long time the attempts to smelt the ore were hindered by a lack of the silicious ingredient required to make a good slag with the aluminous dolomitic ore of the Star of the Congo mine, but the opening of the railway to Kambove has now rendered accessible a supply of the required flux, and has much improved the smelting, which, apart from the defects of the plant, is satisfactory. Another trouble was the cobalt in the ore ; this, as an impurity in the copper metal, entailed penalties. The difficulty has been overcome, and black copper entirely free from cobalt is now made. Of course, the flamboyant guess of Mr. Allan Gibb that Congo copper could be delivered in Europe for £25 per ton may be realized before the Greek kalends, but the best that has been done—and it is a creditable performance—is to market the copper at a total cost of £40 per ton. The two blast-furnaces now in operation are producing 500 tons of copper per month, but the rainy season will interrupt this production. No regular output, on a scale proportioned to the ore deposits, is practicable until the new smelting plant is completed. The question of fuel has been largely solved by the erection of coke-ovens at the Wankie colliery and at Lubumbashi. Two-thirds of the total coke supply, which is now adequate for three furnaces, is made at the smelter, simply because the railway rate on coal is so much less than that on coke. Transport to the west coast will be better as soon as the Benguela railway is completed. The date of this seems within sight. Thus the three or four main problems have been solved or are in the way of solution. By the appointment of a competent metallurgical advisor, the enterprise is at last on the eve of becoming profitable, for we have never questioned the existence of large orebodies comparatively rich in copper.

Drills and Drilling.

Just before Christmas, the financial press, on the initiative of the *Financial Times*, began suddenly to expatiate on a great reduction of cost to be effected on the Rand by the use of machine-drills of an improved type. It was even asserted that the saving in labour, by the use of such drills, would be equivalent to 2s. per ton. That means a saving of 20% in wages. Shortly before this episode, a broker, Mr. Durham Stokes, known recently as a persistent bear on Kaffir shares, issued a circular giving reasons why he had decided to go on a new tack and become a supporter of the market; among the favourable factors he mentioned the improvements in machine-drills. Hence a great deal of untechnical enthusiasm in the daily press about the wonders to be accomplished by the new machines. As a matter of fact, at least 70 different kinds of drills have been tried on the Rand, and of these a fair proportion have been hailed, on different occasions, as predestined to make sudden beneficent changes in Rand economics. Mr. Gustav Imroth, at the meeting of the Johannesburg Consolidated Investment Company, and Mr. Leopold Albu, at the Van Ryn meeting, spoke concerning the prospect of lessening the cost of stoping by the use of improved drills, the one gentleman referring more particularly to the Atlas, and the other to the Leyner drill. But in both cases the references to the subject were as cautious as one might expect from careful administrators. Yet, in view of the economies achieved in the Lake Superior copper region, by the use of one-man drills, we are disposed to consider that some degree of optimism is justified.

Both of the drills mentioned are of the hammer type, as distinguished from the older and larger reciprocating machine. It may be worth while to explain the essential differences between the two types of drill. The ordinary reciprocating or piston-drill operates by the force of compressed air as applied to a piston moving backward and forward with the drill-steel to which it is firmly attached, so that the piston and the drill work as a unit. The hammer-drill differs in that the piston strikes the drill-steel, which does not reciprocate, but is driven forward, and forward only, by a succession of rapid light blows. Owing to the fact that the drill-steel does not move back and forth in the hole, it becomes necessary to remove the 'cuttings' or crushed rock; this is done by admitting either water or air under pressure through hollow drill steel. In stoping, the use of solid cruciform steel is practicable because the 'cuttings' fall automatically out of an overhead hole. In both cases compressed air is used wastefully as measured by theoretical efficiency, but the machine is so much more effective than hand-work as to be highly advantageous. The hammer-drill has the great advantage of light weight and low air-consumption, provided the rock is not too difficult, in which case it becomes necessary to employ the heavier piston-drill. The latter has a cylinder averaging 3 inches in diameter, and weighing 250 to 275 pounds, while the hammer-drill has a cylinder of 2 to $2\frac{1}{4}$ inches and usually weighs less than 100 pounds. On the Rand hammer-drills of a heavy type are being used, for the weight is about 150 pounds. The use of water, for removing the debris of percussion and to diminish the dust nuisance, was a feature of the old Leyner drill, a reciprocating machine which came into prominence a dozen years ago. The new development, such as it is, consists in a more general use of stoping-drills of the hammer type. But this, of course, is not at all peculiar to the Rand. In the Lake Superior copper region the one-man hammer-drill has been in successful use for three or four years, and has done so well as to be a cause of labour disturbance, as is seen in the letter from our New York correspondent on another page of this issue. In this Michigan copper region, where lodes of copper-bearing conglomerate and amygdaloid are exploited on a large scale, the efficiency of drilling has increased from 12 to 36 tons per shift, and the cost of stoping has been diminished from 50 cents to 15 cents per ton. These facts ought to be known to persons responsible for the control of operations on the Rand. Of course, such evolutions do not come *per saltum*, but slowly, in the wake of careful experiments. So little is the present deemed to be a crucial moment in the economics of drilling that no new facts concerning either of the drills mentioned are known at the London offices of the companies concerned.

A good example of skilled intelligence in this department of mining economics is illustrated by the work done at the Village Main Reef mine by Mr. W. Calder. As an experienced underground superintendent, knowing how roughly the drills were treated, he ordered that all of them should be overhauled after being used for 52 shifts, to permit inspection and repair. Starting with a small cylinder and a large piston, as the latter becomes worn the former is reamered to an increased diameter in steps of $\frac{1}{32}$ inch, to fit which pistons of standard size are kept in stock. Thus an accurate fit is maintained, leakage prevented, and the drill kept efficient. The drill-fitter is given a contract for keeping the machine in good condition. At the same time, unusual carelessness or roughness of treatment is debited to those who are responsible. The idea of care is established in the place of the old notion that considered a drill and a mule as the two things that could be struck *ad libitum*. Next, Mr. Calder placed a meter on each level for the measurement of compressed air, thereby affording facilities for detecting leakages and checking excessive consumption. The waste of compressed air in a mine is an economic tragedy. The use of such air to ventilate workings is one of the stupidest things done by thinking man. It is an old and silly trick, and it is high time to stop it. We understand that the cost of keeping the drills in order and the decrease in air consumption have amounted to £105,000 in one year at the mines of the Central Mining—Rand Mines group. Even this does not measure the full benefit of such a system as that introduced by Mr. Calder. It is pleasant to add that he is the president of the South African Institution of Engineers.

The Stock Exchange.

Five brokers received an unpleasant Christmas present on December 23 when they were suspended from entering the Stock Exchange for periods ranging from two to five years. This punishment was meted to them for sundry breaches of discipline in connection with the introduction to the market and subsequent transactions in shares of the Casey-Sutton Cobalt Proprietary. Dealing in the shares began before a prospectus was issued or any alternative statement had been filed. Furthermore, those implicated issued a 'market slip' containing assertions considered, by the Committee of the Stock Exchange, to be misleading. Another gross breach of propriety was that of a member who, while only an unauthorized clerk to a firm of members, acted with a non-member as a trustee for a pool in the shares of the company mentioned. A special settlement in the shares has been refused. Severe censure is passed on the firms implicated, outside of those individually punished. In the 'market slip' it was stated that the Casey-Sutton property was on "the same short mountain range" as the Casey-Cobalt, and in a geological formation "identical in structure" with that of the Nipissing, La Rose, and other celebrated mines in the Cobalt district. This, of course, is deceptive, particularly to persons inexperienced in mining. The name of Mr. E. G. Hemmerde, K.C., M.P., is given as the chairman, together with that of Colonel J. D. Beresford as a director. It is quite likely that both of them knew so little about mining as to be unaware of the deceitfulness of the quasi-technical statements mentioned above. In that case they should not have acted as trustees for shareholders or as administrators of mines. Undoubtedly this action of the Committee, following upon the suspension of three other members for irregular conduct in connection with the American Marconi deal, will have a most salutary effect. And none too soon. Public confidence in the Stock Exchange has suffered severely during recent years, for the facilities that it affords for speculation have been freely used for the grossest kinds of manipulation.

Undoubtedly the practice of introducing shares and making a market for them by the issuance [illegible] 'market slips' or brokerage circul[illegible] so avoiding the publication of a [illegible]s, with all its legal obligations, is [illegible] has been much abused, and mainly [illegible]udulent purposes. Of course, every [illegible]gular introduction is not bad, any more than every prospectussed enterprise is good, but the former readily lends itself to chicanery, while the latter affords some slight measure of protection to the public. 'Market slips' are unsigned, so that responsibility for statements therein cannot be legally allocated. Essential points, possibly detrimental to the project, can be omitted, and always are omitted, while the Companies Act compels the prospectus to give such details as purchase price, promoter's profits, and underwriting commissions. Moreover, the wider publication of a prospectus subjects it to some amount of expert criticism, such as may be escaped by the informal method of circularization. In a way the 'slip' is intended to engage the speculative attention of those on the edge of the market with a view to sales before the Stock Exchange grants a settlement, which accords official facilities for dealings with the public. Thus the introduction price is fixed at a high figure before the public has any means of appraising the merits of the enterprise, so that this mode of making a market enables the unscrupulous to establish a fictitious level for the shares at the outset, and to rig the market subsequently without much danger of conviction. In a prospectus, on the contrary, the price of issue is stated, and this price can be compared to the assets offered; moreover, the money received from the sale of the shares goes to the company, which is accountable to the shareholders, and any profits to intermediaries must be clearly stated. Any attempt to 'rig' the market afterward is then checked by a public knowledge of the excess price over that of allotment. In short, the regular method is like that of a respectable shop, while the other resembles that of a fake auction. The sooner it is recognized that methods akin to the latter are disreputable, the sooner will respectable firms refuse to sanction the prospectusless method of issue. Chicanery loves the dark honourable business does not fear the light it is necessary for the Committee of the Stock Exchange to control its membership so that the avenues of speculation may be illuminated at least to a degree making it difficult for footpads and hold-ups to operate with impunity.

Selective Flotation.

During last year the principle of concentration by flotation has made an important advance by the practical demonstration of the fact that mixed sulphides can be separated from each other as well as from the gangue. This new application may eventually have a wider scope than flotation pure and simple. The separation of a sulphide from gangue by the ordinary process is only commercially applicable when the metallic and non-metallic minerals are of similar specific gravities, or when the sulphide is friable and easily lost on a table. In any case, it is only a secondary process to be used after jigs and tables have done their work on the coarser material. At the present time, selective flotation is likewise a process of subsidiary nature, and is only being used for separating galena and blende from slime residue. There appears, however, to be a large field for its application as a primary process for treating the vast masses of complicated sulphide ores found in various parts of the world that at present resist the efforts of the experts in smelting or water-concentration. We shall not here expatiate on possibilities but confine our remarks to current developments at Broken Hill, where the accumulations of slime are now being successfully treated. For some years it has been known that the various sulphides act differently when tested for flotation, and many ore deposits have been reported as indifferent to the action of the process because of the unsuitability of the conditions as to the amount and nature of oil and acid, the range of temperature, and the quality of the water employed. Systematic investigations have been conducted by numerous workers in this country and in Australia with the object of unravelling the results of the immense series of combinations of these four factors. So far, success has attended the efforts of three metallurgists at Broken Hill, namely Mr. Leslie Bradford of the Proprietary company, Mr. F. J. Lyster of the Zinc Corporation, and Mr. J. M. Owen of the Junction North. We do not include Mr. E. J. Horwood's process, as it secures separation by sulphatizing the galena in a roasting-furnace, this introduction of fire metallurgy differentiating the process from those based on flotation alone. The Bradford process is at work successfully at the Proprietary mine. The Australian patents for the other two have been acquired by the Minerals Separation and De Bavay's Syndicate, and the processes are being worked by the Sulphide Corporation, with excellent results. No official particulars are as yet available for publication relative to the Owen process, but information as to the Bradford and Lyster processes is public property. The former raises the blende, leaving the galena to sink, while in the latter the action is the reverse, the galena being raised and the blende sinking. These contrary results are obtained partly by variations in the amounts of acid used and in the temperatures, and partly by the nature of the salts suspended in the water. Lyster uses 2 to 5 pounds of eucalyptus oil per ton of slime as a frothing agent, the ordinary temperature of the air, and no acid. The water contains salts such as sulphates of iron and lime, or nitrates, sulphates, or chlorides, especially of the alkalis or alkali-earths, and it is kept neutral or slightly alkaline. Care must be taken not to have too much alkalinity. Bradford uses a hot solution of common salt, at temperatures from 50° to 70° C., slightly acidulated by 0·1 to 0·2% of sulphuric acid. He adds a small amount of oleic acid and employs agitation and aeration for making the froth. With careful control the blende rises and the galena falls. Though no official information is given relating to the Owen process, we understand that the galena is made to rise in much the same way as in the Lyster process. As both patents are owned by the same company, their points of difference or similarity are of no consequence. The conditions of operation of all these processes are clearly defined, but modifications are necessary to adapt them to particular ores according to their constitution. When once properly adjusted, they are largely automatic in action. We consider it opportune to make this remark and to advise mining engineers and mine-owners to accept the guidance of trained experts rather than trust to their own inexperience in their desire to avoid the payment of royalties. It is mean to cheat a man out of the due reward of his labour, and it is cheaper to pay a royalty of one shilling per ton than to lose three shillings worth of copper down the creek.

Great Cobar.

The annual meeting was not an inspiring performance, yet the directors have reason to congratulate themselves on the outcome. The chairman, Mr. Andrew Haes, apologized for being in poor voice, owing to a recent attack of bronchitis, but as far as we could discern it was his hearing rather than his voice that was defective, for he insisted on others speaking loudly, while quite able to make himself heard. At first, indeed, he won our sympathy as an invalid 'facing the music,' but by the time the meeting was well advanced he waxed vigorous and played an undignified part, supposedly humorous. His speech was remarkable chiefly for its omissions, but this may have been merely sagacious. As Great Cobar affairs go, the less said the soonest mended, from the standpoint of the chair. Mr. H. C. Bellinger was offered up for sacrifice. He has made mistakes, some of them serious, but he was chosen by the board and retained as manager for five years. He was re-appointed a year ago. For his errors the directors also must accept blame. To use him as a scapegoat now is not nice; it is not playing cricket. In the selection of Bewick, Moreing & Co., as general managers, and in the appointment of Mr. G. C. Klug as manager in Australia, the board of the Great Cobar has shown good sense, but why, we may ask, was this step so belated? If it is recognized that a board in London cannot manage a complicated copper-mining enterprise through the medium of an individual resident manager, why were five years allowed to elapse before the discovery was made? As to the chairman's attack on the insurgent group of shareholders, it was not made in the best of taste, but it was effective. As we suggested in our comment on the insurgents' meeting, the fact that Messrs Rowland Feilding and Kimber Bull were apparently desirous of becoming themselves directors served hugely to discount the sincerity of their attack on the board. Of course, the talk about reducing the directors' fees was ridiculous; the directors should be paid more, not less, but there should be fewer of them. The idea that a holding of 16,000 shares, out of 186,542, among 8 gentlemen gave them as individuals any particular right or privilege to control the administration of the company is absurd. Three capable, and well paid, directors without any share-holding would be much more likely to avoid the mess into which Great Cobar has drifted. The chairman said that he "did not profess to be a miner of any sort or kind, or to know very much about it as far as mining goes." Which means that a gentleman without any experience of mining is trying to be the king-pin of an administration directing the affairs of a big mine 13,000 miles distant. The conditions are not conducive to efficiency.

As soon as Mr. Haes had ended a speech remarkably long for a speaker in poor voice, the resolution was seconded formally by Mr. A. R. Stephenson, representing the Barnato group. Then up sprang the dapper gentleman "from Sheffield," whom we recognized immediately as the man who made Lord Harris yawn so fiercely at the Gold Fields meeting. He, Mr. A. B. Bosher, had the same story to tell; he had bought his shares at £5—he appears always to buy them at that figure—and now they were even lower than Gold Fields. Then came his cheerful statement that the directors were quite incapable and ought to be kicked out. He says this sort of thing as if he were asking them to tea. Mr. Bosher is not an effective champion of shareholders' rights; he leaves the impression that he is not unfitly named, for he talks more of it than most people. Mr. C. S. Herzig was the next to speak. His speech was, in effect, a defence of his optimistic report, made for Mr. Rowland Feilding and others. Naturally, the meeting was pleased to listen to him; so were the directors, for he insisted on an estimate of production higher than theirs, as presented by Mr. W. Pellew-Harvey. We have come to the conclusion that Mr. Herzig gained present comfort at the expense of future embarrassment. The failure of the output to justify his forecast was due, he said, to the local staff. He spoke of "local dissensions," and mentioned the fact that Mr. Bellinger was not a miner. Why, then, were the statements of the staff and of Mr. Bellinger, more particularly, accepted with so little reserve in the preparation of Mr. Herzig's report? As for the suggestions concerning the pitch of the missing orebody, we deem them reasonable, and those present listened to them with interest, but they do not justify an estimate of 10,000 tons of copper per annum. Then came Mr. Kimber Bull, on behalf of the insurgents. He spoke well, but by this time the cause for which he pleaded had suffered too much from the exposure of the fact that its leaders were striving to become directors, and from the comic performance of the gentleman from Sheffield. Mr. Kimber Bull spoke of death-bed repentances, of geological investigations that came too late, of childish finance and mismanagement, but, as the nigger delegate at the Chicago convention said, the 'zoological' moment was gone. Then came nominations to the board and wearisome speeches in support of the three directors to be elected. They must have felt uncomfortable. The proceedings were diversified by farcical interpolations on the part of Mr. Bosher. Indeed, the gentleman from Sheffield and the wily old Boer in the chair were the star performers, and not unfitly represented the two sides in a serio-comic controversy that is now dead, for we do not doubt that the position of the board has been considerably strengthened by the blunders of their opponents. Shareholders do not care 'to job backwards' when by so doing they depress the share quotation. Still, it was a tactical error for the directors not to acknowledge some of their blunders and mishaps, attributing more to the labour difficulties and less to their unfortunate manager. If they had done so, they might have buried the past and emerged white-washed. Now the old account still stands against them and they go forward with the slur of having saved their skins at the expense of their representative in Australia. The meeting gave us a feeling of depression. It furnished another example of the inability of shareholders to protest effectively against the bad management of a mining company's affairs.

Antarctic Exploration.

Again we are threatened with a display of the sentimental hysteria usual to Polar gymnastics. Sir Ernest Shackleton, who was knighted and medalled for a previous histrionic performance of this kind, is to lead an Imperial Trans-Antarctic Expedition for the purpose of crossing from one side of the South Polar snowfields to the other. He is to make geological and biological investigations, it is said; and he is to be provided with £50,000 for this purpose. The expedition is blessed by sundry persons who are bemused by the idea that it is highly patriotic and intensely scientific to execute these grand-stand plays under the Polar skies while the newspapers and cinema-shows get fresh material for business. What is the geological work to be done? Most of the land is deeply buried under snow. It is known that the Antarctic region contains coal deposits, but has that more than academic interest? We know that the Poles were formerly tropical and the Tropics formerly glacial, but that geological fact is only astonishing to an ignoramus. Of coal there is a vast quantity in regions more readily accessible, such as China and Canada. It may be mentioned as a curious fact that there is a lot of ice at the Poles, and ice, as we know, is valuable in London and New York during July. The so-called geological investigations are those of a small boy who picks up a few stones and brings them home to ask his father what they are. The leader of the expedition is overwhelmed with applications for service. That is not surprising. For a cheap way of becoming a hero, commend us to a Polar performance. The usefulness of it has gone now that the North-west passage has been found by Amundsen, and proves to be unavailable for maritime commerce, but these Arctic and Antarctic expeditions manufacture heroes wholesale. We happen to know many ordinary miners, lacking the elaborate commissariat and scientific paraphernalia of these Polar explorers, and clad in little more than their digging clothes, who go from Dawson in the Yukon to Nome in Alaska, a distance of 1800 miles, across the snow, for no other purpose than to prospect for gold or obtain employment in the mines. They take no aero-sledges, motor-affairs, or Manchurian ponies, but a simple sled and a trusty dog-team, which has the advantage, recognized by those experienced in the Arctic, of providing not only transport but also food in case of dire emergency. It may be said that these Northern diggers make the long crossing for money, hence they are not amateurs, and hence they are not heroes. We submit that they fulfil a sensible purpose, and contribute to a useful industry. Instead of spending money, time, and men in a mock-heroic traverse of the barren icefields of the South Pole, why does not Sir Ernest Shackleton and his expedition go to Northwestern Canada, where plenty of room for useful exploration exists, especially in the country between the Mackenzie river and Hudson's Bay? There they might find something on which to build productive industry and open fresh outlets for our national energy. But that, of course, would not be heroic, only useful.

Strike Investigations.

By a fortunate coincidence, we have received concurrently the reports on the strikes in the Lake Superior copper region and the Witwatersrand. The investigation in Michigan was made by a committee of three appointed by the Copper Country Commercial Club, an organization of representative business men. The inquiry in the Transvaal was made by two commissioners appointed by the Governor-General of South Africa. In their personnel and in their mode of appointment these two commissions offer an interesting contrast. Both, however, represent an effort on the part of the community to obtain the facts in the case, with a view to guiding public opinion.

The strike in the copper country began on July 23, 1913; the committee reported on October 8. The dispute arose from the intervention of the Western Federation of Miners, an aggressive labour organization, only too well known in connection with the Cœur d'Alene and Cripple Creek strikes of 1904, in the course of which riot, murder, and assassination were freely used to terrify two important mining communities. Previous to last July employment at the copper mines had been given on the open-shop principle; the miners had not been thoroughly unionized, and the managements did not discriminate against union men. Suddenly the leaders of the Western Federation served notice on the various companies, employing 14,300 men, that they must appoint representatives to meet them in conference "for the purpose of discussing the possibilities of shortening the working day, raising the wages, and making some changes in the working conditions." When this pistol was held to their heads, the companies refused to throw up their hands. A strike was declared at once by the Federation, although a large proportion of the working force did not belong to that organization. How many men were among its members and how many voted for the strike is not known. Violence and bloodshed ensued. Only 5445 men remained at work. The committee finds that the average wages to miners is \$3·20, and to trammers \$2·63, per shift, which ranges from 9 to 10¼ hours. The housing and general care of employees is commended. Complaints have been made against the use of the one-man drill and the contract system, both of which the evidence shows to be unwarranted. The complaint that the men cannot have access to the managers to ask for redress against occasional injustice from shift-bosses and the demand for an 8-hour shift are given favourable consideration by the committee; and by their attitude on these questions we conclude that they were both intelligent and just. But behind these, not unimportant matters, looms the sinister shades of the Western Federation. Those in charge of the mines are unanimous now in announcing that hereafter no member of the Western Federation will be employed by them, and that under no circumstances will they recognize that particular organization. Having an intimate knowledge of the mining regions of America and a close acquaintance with some of the doings of the Federation, we appreciate the resolute refusal of the managers to recognize that conspiracy of labour agitators. Public opinion in America will endorse their uncompromising attitude on this point. It is not a question of humane treatment or economic justice to workmen, it is a question whether the mining industry of the Lake Superior copper region is to be tyrannized by a band of conspirators. It is not a question of collective bargaining, of the rights of capital and labour, of adjusting hours or wages; it is the question whether a Mafia or a Black Hand is to terrorize legitimate industry.

The strike on the Witwatersrand began on June 13; the commissioners issued their report on November 18. They availed themselves of legal procedure and had the aid of three lawyers, for the purposes of examining witnesses. As in Michigan, the organization that had called the strike refused to give evidence. Representatives of the strikers absented themselves, and the commissioners did not go forth into the mines and mills to gather information, as was done by their analogues in Michigan. The Government, the mining companies, and the professional class contributed facts and opinions. The immediate cause of the strike was an order from the manager of the Kleinfontein mine that working hours for five underground mechanics should be the same as for all employees, namely, from 7.30 a.m. to 3.30 p.m. daily, including Saturday. Previously these mechanics had been accustomed to quit at 12.30 p.m., ensuring them a Saturday half-holiday. In effect, therefore, the manager insisted on three hours more work on Saturday, without extra pay. The five men refused to accept the new conditions; they were discharged; two pump-men resigned in sympathy; the Amalgamated Society of Engineers called upon its members to stay away from the mine; the manager and the directors made some ineffective efforts to adjust the dispute; they failed; and on May 26 a vote of the white workers decreed a strike on the property. Just at this time an Inspector of Labour asserted that the manager had broken a Transvaal law in having failed to give a month's notice of the change in the hours of work. Whereupon the legal notice was posted at the mine. The Minister of Mines assumed that the manager could be prosecuted for his infraction of the law; but the commissioners state now that he was in error. The Minister advised the withdrawal of the notice, and a yielding of the original point in dispute. And so the muddle grew. The men had reason to think that the law was set aside in the interest of the company. The commissioners consider the manager to have been "tactless and precipitate." They say that the company "should have candidly admitted its error" instead of ignoring the men and writing a letter to the deputy-mayor. This did no good; thereupon the managing director made proposals to the men; these were "scornfully rejected." By this time the issue was hopelessly confused; from the Saturday half-holiday the strike committee passed to a demand for an 8-hour shift, bank to bank. The Prime Minister was asked by them to introduce a bill forthwith, and so prevent "a general industrial conflagration on the Rand." A domestic quarrel threatened to grow into a political problem. The control of events was passing from the Kleinfontein management. A mass meeting of the Transvaal Miners Association on June 1 approved of the local strike committee's action. The Kleinfontein management refused to meet the strike committee because they were not employees of the company. It became the old question as to whether a union was to be recognized. A principle was now at stake. The men insisted on presenting their grievances through representatives capable of making a good case in their behalf; the company refused to discuss its domestic affairs with trade-union officials not in its service, on the ground that a large proportion of its employees, not now members of a union, would immediately become members and be in a position to demand the employment of none but union men. The commissioners suggest that the companies themselves are in a union, for they are "bound together in groups, and in all important matters they consult the mining groups and the Chamber of Mines." For the sake of those not conversant with South Africa affairs, we may explain that the 'groups' are firms or corporations controlling the promotion, financing, and administration of sundry mining companies. Out of the 51 active mines on the Rand 42 are controlled by 6 such financial units. The men argued truly that a spokesman in their behalf may easily irritate or offend a manager or director; it is not unreasonable to ask that "they should be represented by independent men who need neither fear nor fawn on the directorate or the management of the mine." This is the opinion of the commissioners. The combination of capital was met by a combination of labour. Thus the quarrel at the Kleinfontein involved the mining industry or the whole Witwatersrand. Too late the company agreed to revert to the old Saturday hours for underground mechanics, and made other concessions; the strike committee asked now that all work should cease at 12.30 on Saturday; this the company refused. New men were engaged in place of those who had left. In addition to their former requests, the men now demanded the dismissal of the strike-breakers or non-union workers. At this stage the Kleinfontein management was frankly being "guided by the combination of mining groups" and the men had no chance of winning except through a general strike. A trial of strength was inevitable. The men at the Van Ryn and New Modderfontein came out. Inflammatory speeches were made. Assaults became common. Mobs terrorized the commercial population. At Benoni, a suburb close to the Kleinfontein mine, the scum of the population gained the upper hand. Cruelty and barbarism were rampant. The troops were called out. Finally, on July 4, a big meeting in the Market Square of Johannesburg was called by the strikers, but prohibited by the Government. Mounted police were on hand when the mob assembled in defiance of authority. Roughs, criminals, and the dissolute riff-raff of a mining community mixed with genuine miners and idle sightseers. A riot ensued. The police were stoned. Later in the evening another outbreak ensued, and the troops had to come to the help of the police. Gun-shops were looted. A heavy fire was directed against the military. They were compelled to take the offensive. Among the casualties were 14 officers and men wounded with shot or bullets, and 13 with other missiles. In the mob 20 were killed and 200 wounded. Early on the morning following this night of savagery, the strike-leaders and members of the Government came to an arrangement, whereupon the shooting and rioting ceased. The commissioners conclude that the police exhibited "bravery, patience, and *savoir faire*." The Government undertook to see fair play in an adjustment of grievances; the men returned to work; and since then the mining companies have agreed to recognize the Transvaal Miners Association, while refusing to deal with the Federation of Trades, a broader organization, which at one time threatened to enforce its demands by a general strike throughout South Africa.

Thus the mine managements in both cases refused to recognize an organization that was not a trade-union but a combination of professional agitators. The Transvaal companies agreed, late in the day, to recognize the miners union, which, in Michigan, had been recognized long ago. In South Africa it was clearly shown that the employers had a combination of their own, and that if the principle of collective bargaining was adopted by one side, it was only fair that it should be permitted to the other; in short, that employees, no less than employers, were entitled to act in unison. In Michigan the employees belong to a variety of races, so that the committee of investigation issued a notice in three languages, namely, English, Finnish, and Austrian. But all the workmen are white. In the Transvaal the strikers were a portion of the 23,000 white men that supervize the labour performed by 200,000 black natives. This introduced a serious factor, for violence and disorder among the whites furnished a dangerous example to the blacks, who far outnumber their masters.

Both in the Transvaal and in Michigan the complaint of unfair treatment by shift-bosses is made. Injustice and discrimination are alleged. This is due, in part, to the bigness of modern mining enterprises and the decreasing moral authority of the manager, who, in many cases, receives his orders from a central office. We have seen the creation of super-enterprises, like the Calumet & Hecla consolidation or that of the East Rand Proprietary; we have not seen the development of the super-men capable of controlling them efficiently. And with mere bigness has gone the humane touch. The manager registers the decrees of the head office, itself controlled by a group of broker-financiers, who identify themselves with the mining property, in disregard of the fact that they may own only a minority of the shares, which are the property of several thousand scattered shareholders, who, in turn, care but little about the rights and wrongs of an economic quarrel so long as the dividends arrive regularly and often. The blame is widely distributed, and for that reason largely ignored. It remains for public opinion to make itself felt, as in these two instances, by impartial investigation, so that all concerned may not, with impunity, transgress the bounds of fair play, which is all that can be asked amid the jarring movements of a complex civilization.

ROYAL SCHOOL OF MINES

University Annexation.—The following letter has been addressed by the Institution of Mining and Metallurgy to the President of the Board of Education.

Sir—The Council of the Institution of Mining and Metallurgy have had under consideration the proposals for the absorption of the Imperial College of Science and Technology by the reorganized University of London, embodied in the recent report of the Royal Commission.

The Council view with the gravest misgiving any such interference with the constitution of the Imperial College, whose functions when fully developed, and even in their present stage of development, they regard as of much greater importance to the Empire, from a technological point of view, than are those of the University of London, important as the latter may be.

Whilst this Institution is chiefly interested in the professional training of metalliferous mining engineers and metallurgists, it is also concerned indirectly with general engineering education. The establishment of the Imperial College was the outcome of efforts initiated by the Institution to re-organize the Royal School of Mines and to co-ordinate higher technological education at South Kensington; and the Institution has taken a foremost part in every stage of the development of the Imperial College and has demonstrated a lively concern for its welfare. These facts have been publicly acknowledged by your distinguished predecessors at the Board of Education who took advantage of annual gatherings of the Institution to announce the Government's action from time to time in regard to the Imperial College. They are brought to your notice as evidence that it is in no spirit of mere opposition or destructive criticism that the Institution approaches the subject. On the contrary it is actuated by the consistent and determined desire to assist in repairing the serious effects of the neglect from which higher technological training in this country has so long suffered.

For two or three years previous to the public discussion of the subject, the Institution had been steadily enlisting the interest and support of persons of influence in the counsels of educational institutions throughout the country, with a view to securing at least the benevolent neutrality of such educational authorities in the establishment of an *Imperial* technological institution.

The active interest and support of wealthy men of affairs were also sought and secured; and every effort was put forth to create a public-spirited interest throughout the engineering professions and industries.

The success of this campaign is evidenced by the munificent gifts which resulted from it; and by the securing of the valuable co-operation of leaders of industry in the efficient government of the Imperial College.

The co-operation of these various elements, which were all essential to the success of the scheme, was sought and secured in the belief that the proposed new college was to be essentially Imperial. Its chief function was intended to provide "the highest specialized instruction" and "the fullest equipment for the most advanced training and research" in various branches of applied science for which no sufficient provision existed elsewhere. Its influence, as the technological centre of the Empire, was to be exercised to raise the general standard of training and to provide special equipment and facilities for extending the boundaries of technological knowledge and practice, which would attract graduates from other colleges and universities for advanced training and research in the more complex branches of technology.

It is not claimed that the Imperial College has achieved its full purpose, but it may be confidently stated that it has advanced a considerable way in that direction. Remembering the great initial difficulties, the Governing Body are to be congratulated on their success; and the Council strongly deprecate the interruption of further development which would result from the violent change in constitution which is proposed.

Apart from the imperial aspects of the question the Council are also of the opinion that the educational spirit and atmosphere of an ordinary university differ widely from what they regard as essential in an Imperial College of Technology whose machinery of administration should be elastic and of the simplest character if it is to keep in touch with, and adapt itself to, the constantly changing productive activities of the Empire. This is fully recognized in the case of most, if not all, of the principal continental technological colleges whose constitutions are quite distinct from those of the universities.

It is unnecessary in this communication to discuss the proposals of the Commissioners for safeguarding the interests of the Imperial College in the event of their proposals being adopted, as the Council's objections are fundamental.

Any well considered scheme for establishing the University of London upon a basis worthy of its name would have the complete sympathy and support of the Council; but they strongly protest, with all respect, against the inclusion of the Imperial College in any such scheme.

The Council trust that the scheme may be modified to the extent of leaving the Imperial College to develop upon its own lines the special functions for which it was established and which they regard as of the first importance to the Empire.

BEDFORD MCNEILL, President.
EDGAR TAYLOR, Treasurer.
C. MCDERMID, Secretary.

R.S.M. Association.—The following circular has been issued by the executive committee:

Dear Sir—You will have heard of the organization of R.S.M. men in the form of an Association of former students and teachers. You have not been approached in regard to the matter until now because the list of names and addresses in the hands of the former Dinner Committee was found out-of-date and otherwise defective. Even now it is far from complete, and we shall be glad if you will, at your leisure, send us the names and addresses of your comrades at the R.S.M. so that none may be overlooked.

This Association was founded by the members of the old Dinner Committee, and was inaugurated at a public meeting on July 22, 1913. Without formal solicitation 150 have become members, and over £600 has been received, the bulk of this being donated by the 20 men who subscribed £25 each and became life-members of the Association. Several others have made donations of £5 or £10. The Association was formed to foster the comradeship, to advance the interests, and to express the opinion of R.S.M. men. All who have been to the School as students or teachers for one year, or more, are eligible to membership.

There is no entrance fee; the annual subscription is half-a-guinea. Will you join your comrades and contribute this small amount annually for the sake of the old School?

The General Committee consists of 18, of whom six retire every year and are ineligible for re-election in the year following. The President and the two Vice-Presidents are chosen from the Committee by the Committee. The Committee at present consists of:

One Year: J. J. Beringer, A. G. Charleton, S. H. Cox, William Gowland, D. A. Louis, Frank Merricks.
Two Years: William Frecheville, Sir Thomas Holland, G. T. Holloway, Ernst Lichtenberg, Bedford McNeill, Guy S. M. Taylor.
Three Years: J. M. Beckwith, Donald Campbell, F. W. Harbord, H. W. Hughes, E. T. McCarthy, S. J. Truscott.

Professor Gowland is President, Professor Frecheville is first Vice-President, and Mr. McCarthy is second Vice-President. The Hon. Secretary is Mr. Rickard, who was chosen by the former Dinner Committee to succeed the late Arthur Claudet, and accepted the Secretaryship on condition that the old students would agree to do something more than dine together once a year. They have done so. They have begun by arranging to perpetuate the Claudet fund for post-graduate students. We have now an organization able to represent R.S.M. men and to protect their interests. Every R.S.M. man ought to join without delay. The Executive Committee appeal to you to do so forthwith. Cheques and postal orders should be made payable to the R.S.M. Association.

WILLIAM GOWLAND.
ERNST LICHTENBERG.
E. T. MCCARTHY.
FRANK MERRICKS.
GUY S. M. TAYLOR.
S. J. TRUSCOTT.
T. A. RICKARD, *Hon. Sec.*

London, January 1, 1914.

It only remains to add that any R.S.M. man who does not receive a circular will know that his name and address are not available to the Secretary. The old list was full of errors of omission and commission, including many who had simply dined annually with the R.S.M. men. The new list is much improved but far from complete. Corrections and additions to the list will be warmly welcomed, and we urge every R.S.M. man to forward the address of his particular comrades and acquaintances at the Royal School of Mines, so that the list may finally become the basis for a new register of old students.

PERSONAL

A. ADIASSEWICH is in New York after his tour through the west of America.

W. T. ANDERSON has been appointed consulting engineer to the East Rand Proprietary Mines, and is succeeded in the position of manager by E. C. J. Meyer.

C. A. BANKS is on a visit from Greenwood, B.C.

R. T. BAYLISS visited New York in December.

G. H. BLAKEMORE has been appointed consulting engineer for the Cadia Copper Co., New South Wales.

W. G. B. BOYDELL has left Tasmania for Kapsan, Korea.

VICARS W. BOYLE, manager of the Bongwelli, is home from Nigeria.

H. T. BURLS has gone to Somaliland.

COLIN CAMPBELL has an office as consulting engineer at Salisbury, Rhodesia.

PERCY CAZALET left for Johannesburg on January 8.

JOHN P. COSGRO is now associated with the International Machinery Co.,at Santiago,Chile.

T. W. EDGEWORTH DAVID is here from Melbourne.

A. E. DRUCKER is expected from Korea.

O. T. GORTON is here from Portugal.

HERBERT HAAS has been appointed metallurgical engineer to the United States Bureau of Mines.

H. J. S. HEATHER has been appointed professor of electro-technics in the South African School of Mines.

C. S. HERZIG has moved to No. 1 London Wall Buildings, E.C.

G. F. JAKINS has been appointed assistant engineer at the Mount Lyell mines.

H. H. JOHNSON has returned from Canada.

T. J. JONES, mine superintendent at Kyshtim, is here.

S. RAMPLEN JONES has left for the Federated Malay States.

JOHN H. KLEPINGER has been appointed superintendent of the Great Falls smelter of the Anaconda Copper company.

G. A. LAIRD is the new manager of the Chesney mine and mill belonging to the Great Cobar company.

W. RYAN LEWIS is returning to Russia.

JOHN C. MANCE is here on a short visit from the Central Province of India.

J. M. OWEN, mill superintendent of the Broken Hill Junction North mine,and inventor of a selective flotation process, has gone to America.

MUNGO PARK is staying in Wales.

R. G. PEARSON has gone from Nigeria to the Cape, for W. Mertens & Co., Ltd.

WALTER G. PERKINS returned to London from Korea by way of the United States.

E. F. PITTMAN is preparing a handbook on Australian mining for the information of the British Association visitors in August.

F. DANVERS POWER is in London.

R. M. RAYMOND and ALFRED F. MAIN were at New York just before Christmas.

J. HENRY RICKARD is in the Ninkada district, Nigeria.

G. A. ROUSH, a professor in the Lehigh University, has been appointed editor of 'The Mineral Industry.'

CHARLES SALTER has left for Perak.

H. ROSS SKINNER is here from the Transvaal; he has resigned as consulting engineer to the East Rand Proprietary.

J. ERNEST SNELUS returned to Nigeria on December 31.

S. S. SORENSEN has been appointed manager of the Braden copper mine, Chile.

ROBERT C. STICHT has left Melbourne on a trip round the world.

J. W. TEALE, of Bainbridge, Seymour & Co., has returned from Burma.

BENJAMIN B. THAYER, president of the Anaconda Copper Co., has been nominated for the presidency of the American Institute of Mining Engineers.

W. E. THORNE is going to the Ropp property, Nigeria.

CHARLES F. TROUSDELL has returned to the Bisichi mine, in Northern Nigeria.

J. B. TYRRELL has been retained as advisory engineer in America for the Anglo-French Exploration Co.

L. E. DE VILLIERS has been appointed manager of the Nigel mine, Heidelburg, Transvaal.

J. C. VIVIAN has returned from Queensland.

GEORGE F. WADDELL has been appointed manager of the Ohio Copper Co., Utah.

ARTHUR L. WALKER, professor of metallurgy in the Columbia University, is recovering from an attack of typhoid fever.

EDWARD H. WATSON is again in Siberia for the Olekma-Vitim-Lena syndicate.

A. E. WHEELER, of Great Falls, has been appointed consulting engineer to the Union Minière du Haut Katanga.

W. FISCHER WILKINSON has opened an office at 35 Queen Victoria St., E.C.

R. B. WILLIAMS has joined the staff of the Niger Company.

GORDON WILSON remains at Zacatecas.

SPECIAL·CORRESPONDENCE

MELBOURNE.

General.—By the time this reaches London the year 1913 will have ended, and so far as Australian mining goes, it can be said of 1913 that it has not belied its number. The whole 12 months has been a period of intermittent warfare between employer and employed. Every mining district has been affected and there are signs that this discontent will be carried into the new year. No more than this need be said on this subject, except to point out that the willingness of capitalists to equip prospecting parties or to engage in speculative mining has been limited by the disaffection prevailing among the working classes. The year 1913 also has been unlucky in as much as it has not seen a single mineral development of real importance in the whole of this huge continent. The general prosperity of the community may be responsible, in part, for this, because when high wages are available in settled districts, either in mining or in other pursuits, men are lured away from the strenuous life and the hardship of the prospector to the ease of settled and comfortable avocations. The geological staffs of the different States do not carry out reconnaissance work, their duties being mostly confined to examining known fields. The general wish, however, in every part of Australia is that some new mining centre shall be discovered; and as that feeling is extending, it is no stretch of imagination to say that it will be easy to induce the governments of Western Australia, South Australia, or the Northern Territory to provide a substantial reward to anyone who would find a mineral field of any importance in the huge desolate areas of the interior. There is immense scope for prospecting, but today the capital is not available to induce men to go out in search of mineral on the mere chance of finding it, so until some spirit of enterprise in this direction is developed we shall have to be content to see our existing mineral deposits steadily depleted.

Broken Hill.—The mainstay of the mineral industry of Australia during the year, apart from coal, has been Broken Hill. There, mines like the Proprietary and the Block 14 have their lives absolutely defined; still even an old stager like the Block 10 has come upon a fresh development in the form of a fair sized body of lead sulphide lying west of the main lode. A great deal of boring has been carried out on the 3,000 ft. along the line of the lode owned by the Proprietary, but unfortunately, no good results has been obtained. In the Block 14 lease the position is the same, but in the British mine a large body of ore has been opened up in the new shoot off Thompson's shaft. On the whole, however, this formation is low-grade and, therefore, can be looked upon only to give good returns when the price of metals is high. Farther away at both ends of the field developments have been exceptionally satisfactory. To the north, the North Broken Hill mine has bored across the shoot of ore at 1400 ft., proving its width to be 117 ft. of a grade higher than that on the levels above. To the extreme south, the South Blocks, the South Broken Hill, and the Central mines all have had such encouraging developments at depth as to afford an assurance that their life will be much longer than was thought possible even so late as a year ago. In addition to the opening-up of additional ore reserves on a large scale, the metallurgy of the field has been advancing apace. The evolution of the flotation process into a selective process by which the lead and zinc sulphides can be floated off separately, at will, is now practically complete. This means that the treatment of the slime dumps of the different mines can be carried through and a most profitable recovery attained. To illustrate what this means, the case of the South Broken Hill mine can be cited. There a dump of 400,000 tons of slime has been accumulated and is being increased at the rate of 1100 tons per week. It is computed that the experimental work carried out assures a profit of £1 per ton on this material. As this is apart from the profit made in the first instance on the recovery of lead concentrate, and next of zinc concentrate by ordinary water concentration and flotation, a very important addition must be made to the revenue of this and of other companies. It can be seen, therefore, that there is every reason to believe that the prosperity which has marked the course of mining at Broken Hill during the last three years will be even greater in the near future, provided there is no absolute and permanent break-away in the price of metals.

Copper.—So far as copper mining goes it cannot be said that there has been any real progress during the 12 months. The fire at the North Lyell mine and the consequent flooding of the property interfered with operations at the Mt. Lyell works at Queenstown. During the interval the company continued experimenting with the flotation process for the treatment of the low-grade silicious ores which exist in such large quantities in the Mt. Lyell district. It can now be said that the staff of the company feel they are on the highway to success with their work. Should this be the case, then the life of the Mt. Lyell Mining & Railway Co. will in turn be prolonged. Probably more far-reaching in its results will be the application of the flotation process to the huge undeveloped bodies of complex ores in the Rosebery district, in northern Tasmania and near to Zeehan. It was at one time suggested that the Oker process should be applied to the treatment of these ores, but that idea has been abandoned, owing perhaps to the inability to secure the co-operation of capitalists in Europe and Great Britain. Local investors, therefore, intend to direct attention to solving the problem of the treatment of these ores by using the Horwood roasting process and the flotation process. So far as the silver-lead zone at Zeehan goes, there has not been a discovery of importance for years. In New South Wales the worst feature in copper mining has been the collapse of the Great Cobar. The grade of the ore in this property has got down to about 1·6% copper and there seems to be a strong opinion that the only hope of the concern is for a complete re-organization of its finances. In Queensland the re-modelling of the Mt. Morgan plant has been steadily carried out. Underground the operations have had to be modified to enable such an output to be maintained as would meet the necessities of the smelters. It is expected that the results of this work and the large expenditure involved at the surface will be manifest during 1914. Farther north the Great Fitzroy, working on an exceedingly low-grade material, has solved the treatment of its silicious ores by means of the flotation process, a recovery of over 80% of the copper and the gold in the ore having been obtained. This company has also been developing a New Guinea copper formation with satisfactory results. In the Cloncurry district of Queensland also mining has progressed, although the share market has been against the investor. At the Mt. Elliott, no real developments of importance have occurred at depth and the same can be said of the Hampden mine near-by. The Duchess mine, belonging to the Hampden company, has carried down rich ore below the No. 5 level, thus proving itself to be one of the most valuable properties in the locality. Strikes and interferences with work due to the dry weather have told against the field to some extent and its fortunes are likely to be somewhat affected for a little while by the hanging up of the construction of the second section of the Mt. Cuthbert railway. This line was to terminate at a group of mines, but is being left off half-way thither. The railway would have also assisted the Mt. Oxide district, where large interests have been acquired by leading London and Paris investors. Other copper-mining properties such as the Wallaroo and Moonta, in South Australia, are working out their resources. So that it can be said that the only two new districts of any promise for the future are the Rosebery and North Queensland. Exploration is going on in the Northern Territory with the hope of developing copper properties there, but so far nothing out of the way has been found.

Tin.—The fall in the price of tin has not checked the search that is being made in different parts of Australia for fresh alluvial deposits of black tin. In a distant corner of the Northern Territory it is announced that fair deposits have been found, also that lode formations of good grade exist. The locality is so outlying that so far no definite opinion in respect to the extent of the stanniferous area can be ventured, but it would surprise nobody if a find of importance was made in that part of the Commonwealth. All down Queensland also more systematic attention is being devoted to alluvial deposits. Melbourne capital is helping in this work in several quarters and it is expected that fair yields will be obtained from some of the claims that have been systematically sampled by mining men on behalf of Southern capitalists. Sydney people are not doing much in their own State except to work, by dredging and hydraulic sluicing, the shallow surface deposits near Inverell.

They, however, are backing strongly equipped parties in the Malay States, and the news is just out that at least two or three strong companies, having their head-quarters at Sydney will be formed to deal with large areas of tin drift in that part of the Orient.

Gold.—The position of the gold industry has been left to the last, and it cannot be said that anything very cheering can be written about it. The output of gold for the first 10 months of this year amounted to 1,829,128 oz. as against 1,911,317 oz. for the corresponding period in 1912, and 2,072,110 oz. in 1911. Thus there has been a falling off of nearly 250,000 oz. in the output as compared with the yield for the first 10 months of 1911. This reduction arises from a decrease of output in every one of the States. The reason is not difficult to furnish. In Victoria, for instance, the Ballarat district is pretty well worked out, and, with the exception of Ararat, alluvial mining is on the wane. In the latter field, developments on the Langi Logan gutter promise to restore interest in alluvial mining. The wash has yet to be entered, but the boring into the gutter from the main under-levels has given such satisfactory prospects as to induce the hope that another 'deep lead' system may help to place the gold return on a better footing than has been the case for some time. At Bendigo none of the side lines has yet been shown to equal in wealth the main lines worked with such remarkable success during the past 20 years. In the mountains mining is almost at a standstill. In New South Wales there really is no serious gold mining industry and in Queensland it has to be admitted reluctantly that the great Charters Towers field is decidedly on the wane. The scheme for granting a State subsidy for the sinking of a deep shaft at Charters Towers has not received the support of the Government, and so the hope that existed that mining would benefit from such an exploratory work has disappeared. South Australia, the Northern Territory, and Tasmania do not contribute materially to the gold yield. Western Australia, however, is maintaining its average output, having been helped in this direction by the developments that have taken place at several of the mines in the Yilgarn district. Nobody can say, of course, when a discovery may not be made in the huge extent of this State or in the Northern Territory, and in the back blocks of Queensland. A continent lies here awaiting exploration, but the rigours of the climate and the desolate nature of the country preclude more than skirmishing work.

BROKEN HILL, looking west.

CAMBORNE.

Phœnix Mines.—The meeting of shareholders, at which the accounts for the fifteen months ended September 30 were presented, was chiefly remarkable for an announcement that the Duchy of Cornwall had agreed to subscribe £7500 on the security of 6% first mortgage debentures for the further development of this famous tin mine, subject to the company undertaking to provide a similar sum. It will be recalled that the King and Queen, when Prince and Princess of Wales, visited this property for the purpose of starting the new Cornish pumping-engine. So far as I am aware, the provision of money for mining operations is a new departure on the part of the Duchy authorities, and it is a move that will be welcomed by all interested in the development of the County's mineral resources. It is in distinct contrast to the Duchy's attitude respecting the renewal of the Levant lease, where, it was recently asserted by H. E. Olds, one-third increase in dues was being demanded and an undertaking that £60,000 should be spent on the mine, terms which anyone knowing the conditions at Levant must regard as far too exacting. However, to return to Phœnix. It will be recalled that in September 1912, Bewick, Moreing & Co. were appointed general managers, and arranged for £50,000 new capital for the purpose of paying off the existing debentures and liabilities and providing funds for further development. I then ventured the opinion in these columns that £50,000 was not an adequate sum for the purpose, and the provision now by the Duchy and others of a further £15,000 confirms the accuracy of that forecast. For the fifteen months under review, the expenditure was as follows:

	£
Development	24,181
London expenses and Debenture interest	2,491
Machinery and Plant	627
Buildings	1,053
Underwriting commissions, etc.	5,128
	£33,480
Less sundry receipts	576
	£32,904

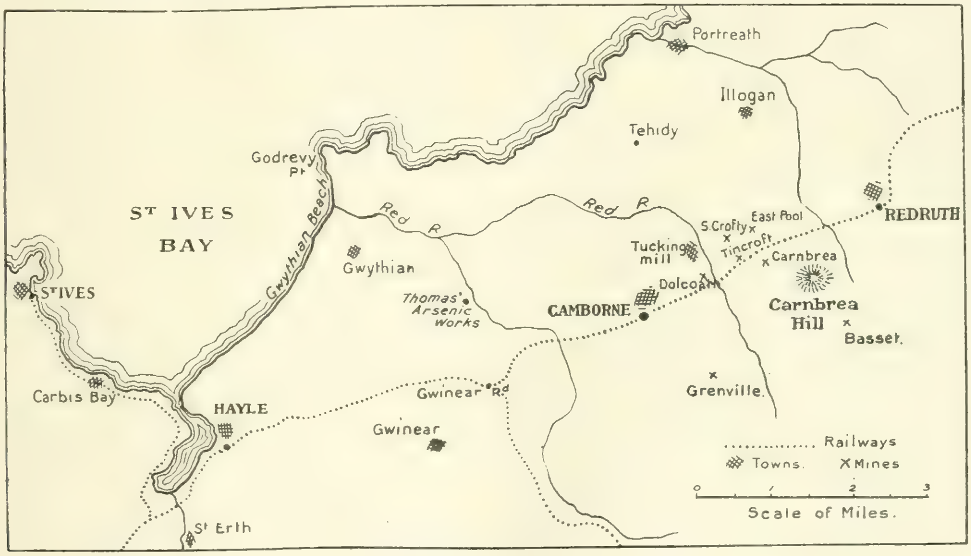
It has been proved that, contrary to the anticipations of those responsible for the re-opening of the mine, there is no profitable ore to be found in the old workings, so once more it has been demonstrated that the old Cornish miner never left ore standing. It appears from an inspection of the old workings that the pay-ore existed in shoots. A vigorous programme of development in virgin ground at several points is therefore now necessary to open-up sufficient ore to keep a mill going. So far the developments have disclosed chiefly low-grade ore. It is worthy of note that the report above-mentioned was not distributed to the Press, and that no account of the proceedings at the meeting of shareholders held on December 15 has been published.

East Pool & Agar.—The intersection of what is likely to prove to be the Great lode in the 160-fm. cross-cut north from East Pool shaft is a development fraught with great possibilities. For years, one or two people, who have carefully studied the East Pool lodes, have been of the opinion that a section of the Great lode was standing to the north of East Pool shaft. The lode that has been discovered has the dip and usual characteristics of the Great lode, and although of low grade at the point of intersection, it is felt by the management that so soon as granite supersedes killas (and the granite can only be a little depth below the 160 cross-cut at this point) the lode will materially improve in value. If this forecast proves correct, the new superintendent, T. Taylor, will have made a fortunate start; but clearly the credit of the discovery must be given to the late superintendent, E. P. Jennings, who persevered with this work in face of many doubts expressed as to its value.

St. Ives Consolidated Mines.—It would appear from the speech of the chairman of the company and from the report and accounts, made up for the twelve months ended June 30 last, that the prospects of this undertaking are brighter than ever previously. Virgin ground is being developed, and according to the statement of the manager, F. C. Cann, the assay-values indicate profitableness though they are not particularly high. Frank's shaft in the Giew section seems to be an exceedingly promising development point. The lode for the 35 ft. sunk below the 142-fm. level averages 30 in. in width and 30 lb. of black tin per ton, and this after excluding a 12-in. leader assaying 240 lb. per ton. The financial position is not satisfactory. It is a pity that the Giew property, which worked by itself and moderately capitalized, would probably show a fair return, should have to carry the capital burden of the St. Ives Consolidated Company. There can be no expectation for years to come of dividends for the shareholders on the huge capital involved, judging by the balance sheet recently presented, unless the radium side of the business proves to be a greater success than local people anticipate. The profit and loss account shows that 233 tons of black tin was sold, realizing £28,644, while stocks and interest bring the total receipts to £31,463. On the other side, the working expenses at the mine (excluding development, which is charged to capital) figure at £22,432, and expenses in London at £7858, together £30,290, leaving a profit of £1173. The amount charged to capital for development was £12,172. The statement of working costs at Giew is given separately, and shows that on a tonnage of 22,839 tons milled, the expenditure at the mine, apart from development and London expenses, was 15s. 11·64d. per ton. The mill is now being enlarged by the addition of 10 stamps of 1200 lb. each, and a tube-mill; it is hoped by this means to materially reduce costs. No statement of ore reserves is given, so that it is impossible to judge whether an output can be secured to keep the enlarged mill going without treating stuff of a lower grade.

The chairman made two claims for the Giew mill that will not receive acceptance without figures to justify them. First, he said that, in the existing mill, a tonnage record had been established so far as Cornwall was concerned, and secondly that the present working costs compare most favourably with those of any other tin mill of similar capacity. Unquestionably, the Giew mill is of excellent design, and no doubt the running cost as a consequence is low, but until figures are presented to justify the chairman's statements, his claims will not be admitted. An element of confusion is introduced into the directors' report and accounts for the year ended June 30 by the fact that the accompanying manager's report deals with the operations for a different period, namely, the year ended November 30.

Dredging for Tin.—I have from time to time referred to schemes for dredging St. Ives bay, the river Fal, and Falmouth harbour for tin, all of which have been opposed by those interested in the local fishing industry. Recently conferences have been held of all parties concerned, with an inspector of the Board of Agriculture and Fisheries in the chair, as, before dredging operations may be commenced, a license has to be secured from that authority. It would appear that the concessions at St. Ives bay to dredge had been granted by another government department, the Office of Woods and Forests; that the area covered 8½ square miles, or about 5400 acres; that according to D. Gill Jenkins (one of the concessionaires) no sample he had taken had assayed less than 10 lb. of tin per ton of sand (whether by chemical or panning assay was not stated); that it was proposed to treat 2000 tons per day and to operate in water varying in depth from 2 to 9 fathoms, sending the sand ashore for treatment; while C. V. Thomas (also a concessionaire) asserted, to the obvious astonishment of everyone, that there was lying in the bay "anything from £20,000,000 worth of tin to a figure which it would be impossible to name." The opposition expressed the opinion that the proposed operations would detrimentally affect the chief fishing and spawning grounds on the eastern side of the bay, for it was on the herring spawn, small fry, and insects that the pilchards fed, and the dredging would disturb this food. No decision was made, the inspector remarking on the



PART OF CORNWALL.

absence of definite data from the promoters, and suggesting that some experiments should be carried out before going further. In the case of the river Fal, the opposition came from the oyster-fishing interests, and here again the matter was adjourned for a definite plan of operations to enable the inspector to judge whether the proposed operations would be detrimental to the fishing interests and a hindrance to navigation.

Contract System.—The attempt of Bewick, Moreing & Co. to abolish at East Pool what is known as the contract system of pay, which is in general use in Cornwall, resulted in a refusal of the men to go underground, and in the end, the new regulations were withdrawn, but whether temporarily or not is uncertain. Under the contract system, the 'taker' of the 'pare' or gang is paid the whole of the amount earned by the 'pare,' and he distributes the money among the men and boys constituting it in such proportions as he may previously have agreed with them. The boys he usually pays £2. 10s. to £3 per month, and he justifies this low wage by a claim that he is teaching them their work, or in other words they are serving a sort of apprenticeship for which he claims a part of the value of their services, as a payment for supervision and instruction. The manager of the mine has no control of the members of the 'pare,' so far as wages paid or time worked is concerned, and frequently shifts are missed by one or other member without penalty. This is an unsatisfactory state of affairs, for the standing charges of the mine continue the same whatever the output, and it is necessary to get a maximum of shifts worked. The management of any mine is entitled to, and indeed ought to, know the rate of pay of all employees per shift, and how many shifts they work. The older men were opposed to any change that involved payment for actual shifts worked at a fixed rate, as their share for so-called supervision would vanish, and they were able to persuade the younger men to follow their lead.

It is always difficult in Cornwall to abolish old customs, but it is hoped for the sake of the industry that the attempt will be made again, after it has been clearly demonstrated that the genuine worker would not be a loser by the adoption of the shift system of payment.

Another difference with the men was the proposal to close all contracts on the 15th day and at the end of each month. This would have resulted in two pays per calendar month, the company only holding three days pay in hand instead of two weeks pay as at present, and would have replaced the existing four-weekly pay with subsist at the end of the second week. The change was necessary to enable the general managers to figure their costs, etc., per calendar month. The opposition of the men was based on the opinion that this change would result in their only having 12 instead of 13 pays a year, an absurd contention in view of the fact that the men were to be paid on shifts actually worked. One point for consideration presents itself, and that is whether the change proposed would not contravene the Stannaries Act, which stipulates that the miners must be paid each two weeks; two pays for each calendar month must of necessity infringe this rule. The officials of the Workers' Union (which organized the recent strike of clay-workers) took advantage of the strike to urge the men to join the Union, but without result, for the metal miners of Cornwall are a conservative race.

TORONTO.

Cobalt.—Shipments of ore and bullion from the camp during the last few weeks have been heavy, the difficulty experienced recently in marketing ore owing to the lack of smelter facilities having apparently been fully overcome. An increasingly large percentage of the output is being sent in the form of bullion, the total consignments of which for the year up to December 20 amounted to 9,014,445 oz. valued at $5,290,409. The new Northern Customs concentrator is nearing completion. One-half of the 80-stamp battery is now in working order, and the remaining 40 stamps will be ready shortly. The plant has been constructed in record time, as the ground was not broken until the first week in September. When the mill is in full operation 60 of the stamps will be employed on La Rose ore, and the other 20 on the output of the Drummond. A noteworthy feature in connection with the building of this mill is that the greater part of the machinery was manufactured in Northern Ontario at the Wabi Iron works, New Liskeard, only the heavier items being brought from a distance. It is proposed to add more stamps next season to enable the company to carry out a contract with the Chambers-Ferland. During November the Nipissing mined ore of an estimated net value of $159,220, and made shipments, with custom ore, of an estimated net value of $367,153. At the third level of the Meyer shaft three extensions of branch veins were cut, and a new high-grade vein was discovered in the cross-cut between shafts 64 and 73. La Rose during November produced 194,882 oz. silver, valued at $110,931, making a profit of $70,424. The cash surplus was $1,772,161. Some disappointment was felt that the directors did not see their way to a more liberal distribution of the funds on hand than the modest quarterly dividend of 2½% supplemented by a 2% bonus. The Beaver, after a year's intermission, has declared a 3% dividend. The available balance on hand as of November 30 was $134,335. A hoist capable of raising 4 tons at the rate of 1800 ft. per minute is being installed preliminary to sinking the shaft from 1500 to 2000 ft. Work on the deeper levels has been discontinued in the meantime. No high-grade ore so far has been found on the 600-ft. level, but there is a large body of milling ore, and the upper levels continue to yield well. The Peterson Lake is opening the Kerry shaft on the 200-ft. level, and will develop an area of conglomerate between the Kerry and St. Anthony shafts, and also between the latter and the main shaft. The Seneca Superior has cut the Worth vein on the 100-ft. level on a cross-cut from the No. 2 shaft. It is 4 in. wide and stated to assay 5000 oz. silver. During November the McKinley-Darragh produced 187,800 oz., of which the Savage mine contributed 58,008 oz. The rich ore-shoot recently found has proved to be continuous for 60 ft., and holds out well in the winze sunk from the 140-ft. level. The application of the Cobalt Lake Mining Co. for permission to drain Cobalt lake is now under consideration by the mining commissioner T. E. Godson, who is making a personal examination of the locality previous to giving a decision. [This permit has been granted.—EDITOR]. The 8-hour law for miners goes into effect on January 1, and the Cobalt mine-owners have altered their schedules of working hours in compliance with its conditions. Special instructions have been issued by the Department of Mines and the mining inspectors to see that the law is observed, and no difficulty in enforcing it is anticipated.

Porcupine.—The 4-weekly statement of the Hollinger for the period ended November 4 shows gross profits of $124,995, and a surplus of $757,574, of which $507,574 represents cash and gold assets. The total ore mined was 13,210 tons of an average value of $15. The mill ran 95% of possible running time, and the extraction was 96·1%. The cost per ton of ore milled was $5·05, a considerable reduction as compared with previous reports. In the mine the winze below the 425-ft. level had reached a depth of 22 ft., at which point the vein was 8 ft. wide, assaying $17 per ton. Since the statement was published it is announced that a considerable addition has been made to the ore reserve by the discovery of an extension of No. 2 vein on the 200-ft. level. It is stated unofficially that the November output of the Dome mill was $121,349 from the crushing of 13,820 tons. This makes an average of slightly under $9 per ton. The Crown Reserve of Cobalt has dropped its option on the Vipond, otherwise known as the Porcupine Gold. The Crown Reserve was desirous of securing the adjoining North Thompson property and working the two together, but the latter was acquired by the Associated Gold Mines of West Australia. Conrad Wettlaufer and associates, after doing extensive development work on the Clon Veteran claim, in Hoyle township, have thrown up their option, as the encouraging surface indications disappeared in depth.

General.—The Appellate Division of the Supreme Court of Ontario has rendered an important decision in the case of Perron *v.* Hurd. The parties staked adjoining claims in the Kirkland Lake district that overlapped by two chains, Perron having made a mistake in measurement and staked too much. He claimed that he had complied with the requirements of the Act, which said that the measurements were to be "as accurate as could reasonably be ascertained," and that it was practically impossible to give exact measurements in staking the claim. The Court held that all claims registered to be valid must be accurately measured, and that a prospector is not entitled to more than 20 chains of land on one claim.

The annual report of the Consolidated Mining & Smelting Co., covering a period of 15 months in accordance with a change in the financial year, indicates a considerable improvement in the British Columbia mining conditions. The profits for the 15 months, after allowing for development and depreciation, were $998,367, as compared with $310,345 for the previous year. The mineral holdings have been increased by the acquisition of several properties, the property account being higher by $232,113. The total tonnage smelted at Trail, British Columbia, was 407,124 tons, having a gross value of $8,335,668, showing an increase of 2400 tons in the average monthly tonnage smelted last year. The balance at the credit of profit and loss at the close of the year was $1,717,650.

JOHANNESBURG.

The Consolidated Gold Fields annual report for the year ending June 30, is chiefly interesting by reason of the views of its consulting engineer, Mr. H. H. Webb. Dealing with selective mining, he is of opinion that such a policy is quite legitimate when employed to bridge over a temporary period of depression in development, a momentary advance in working cost, or to maintain a fair profit while extracting low-grade reclamation rock from old stopes; and he states that there are no mines working, that he knows of, in which at times a process of selection is not necessary, and that this applies, more or less, to all the mines of the Rand. On the controversial subject of decrease of value with depth he is most refreshingly candid. He says, alluding to the Rand mines which his group controls, or is interested in: "And there can be no doubt that from our experience and in our mines the average value of the ore developed over large areas has been getting lower as greater depth is attained." Such a definite pronouncement coming from an engineer of the widest experience and the highest standing should be sufficient to confute the specious arguments of those who have been in the habit of attaching more significance to a few geological vagaries than to the co-ordinated mining experience of the ages. The remainder of Mr. Webb's remarks may be summarized as follows: The fall in average grade has been conclusively proved by the value of the ore milled, recovery value per ton, sampling of successive levels, sampling of stopes, and yearly recasts of ore reserves. In three years the average recovery grade of the group, in spite of improving extraction, has fallen 2s. 7d. per ton, and the average working cost has fallen 1s. 1d. Regarding no-sorting, there is a slight margin in favour of the practice with low-grade mines sorting less than 10% and handling large tonnages. The lowering of working cost is imperative if the treatment of the enormous quantities of low-grade ore is to be commercially successful. The closing down of a few such large properties as the Jupiter would mean a heavy blow to the industry and through it to the country of which it is the economic backbone. The burdens laid on the industry will have to be lightened if the maximum ultimate prosperity of South Africa is to be secured, quite apart from the direct benefit to the mines themselves. The general tone of Mr. Webb's remarks is despondent, but that there is good reason for such despondency a careful perusal of his able report will make clear. The whole matter may be boiled down into the question: Can the working cost be reduced proportionately with the decline of ore-value in depth? If the answer be no, then the future of the Rand is indeed anything but bright. On this head Mr. C. D. Leslie, the superintendent engineer of the same group, advances the opinion that the two most important means for decreasing expenditure lie in the saving of native labour by mechanical replacement and by its more effective distribution. It may be as well to point out that the substitution of machinery for the native is going to be a terribly slow process, owing principally to the lethargy of manufacturers and the moderate inventive powers of the present-day engineer, and that the scope for improvement in coloured labour distribution is, on account of political restrictions, extremely limited. Of course no one dares to declare publicly that the greatest obstacle in the way of reducing costs is the colour bar, as such a prognostic dictum would draw down on the head of its originator the anathemas of certain political and pseudo-industrial factions. The removal of this bar would permit of the coloured man's performing work of as skilled a nature as his training and knowledge give him capacity for, much of which is now indifferently performed and at considerable cost by European rock-breakers who, being in possession of a blasting certificate, are classed as skilled miners. It seems highly probable that economic pressure will in the not distant future lead to a partial, if not complete, abolition of the colour bar, at least so far as underground work is concerned; for it is difficult to see how mere sentiment can continue indefinitely to hold back the progress of a country. In speaking of sorting, Mr. Leslie says that on the Knights Deep, where the gold is disseminated over considerable widths, loss through sorting has been definitely proved, and therefore the whole tonnage is now sent direct to the mill. The average reduction cost of the group mines, which includes all expenditure on breaking, sorting, stamping and tube-milling, cyaniding, and residue disposal, was 3s. 4d. per ton in the quarter ending June 30, 1913, as against 3s. 7d. for the same period of 1912; figures which compare favourably with 3s. 10d. and 4s. 4d., respectively, for the rest of the Rand.

The Zaaiplaats Tin is a mine of considerable geological interest and of acutely speculative character. The ore occurs in roughly circular pipe-like impregnations along planes of weakness in the red granite of the bushveld with occasional lenticular or tabular offshoots. The pipes dip at a moderate and varying angle with no severe changes in direction, and so as regards verticality and horizontality they may be described as gently sinuous. The premier producing pipe, No. 13, has been followed for a distance of 1,100 ft. With erratic orebodies, ore estimation is always a difficult problem, and the possibilities of grave abuse or of gross misjudgment have to be guarded against. In this case, as the profit-

THE ZAAIPLAATS MILL.

able length of any pipe is purely a matter of conjecture and, consequently the estimation of ore *in situ* futile, the management has adopted the entirely praiseworthy if drastic course of expressing the reserve only in terms of the number of tons broken and dumped. For comparative purposes the results for the past two financial years may be set out:

	Year ending July 31, 1912	Year ending July 31, 1913
Crushed, short tons	29,300	31,894
Accumulations treated, short tons	—	7,400
Concentrate produced, long tons	1,470	1,050
Working cost per ton crushed	35s. 1d.	31s. 6d.
Working profit	£108,365	£80,180
Capital expenditure	£33,437	£8,618
Dividend	150%	45%
Balance of cash and cash assets	debit £26,402	credit £8,896
Ore reserve, short tons	24,622	14,500
Assay-value per ton	3·4%	not stated
Accumulated re-treatable sand and slime, short tons	60,000	52,600

In the working cost the oversea treatment charge is not included, being deducted instead from the gross value of the output of concentrate to obtain its net value. Whether this realization charge should or should not be included in the working cost is a much debated question, and as there is no authoritative body to which to refer it, the way in which it is settled depends upon the personal predilection of the accountant employed to draw up the working expenditure and revenue statement. The result of this obstinate individualism is that those who wish to compare the working cost of one tin mine with another are completely befogged. The company has a capital of £60,000 in 245,000 shares of 5s. each, and since its inception in 1908 has paid out in dividends £276,000, or 460%. It has at last dawned upon the directors that with such a capricious ore deposit a reserve fund is desirable, and a small one is now being built up. The equipment comprises a 15-stamp mill, concentrating plant, subsidiary slime plant, calciner, power and compressor plant, and pumping station. Following the usual practice, the concentrate is sold to the Straits Trading Co. of Singapore, better terms and more satisfactory business treatment being thus obtained than would be the case if the concentrate were shipped to England. In addition to mine ore, the company has a considerable amount of alluvium scattered about over its claims, and this is being treated in rotary pans. Three of these have been erected, the capital cost of each plant being £250. They have a combined daily capacity of 250 tons, provide an excellent extraction, and use only 20% of the water that would be required if sluicing methods were employed. This last consideration is very important in this district owing to the scarcity of water in the dry season. The cassiterite in the ore is coarse and easily recoverable, an extraction of 90% being sometimes obtained over a month's run. For the quarter ending October 31, 8183 tons were crushed and 375 tons of accumulation treated; 324 long tons of concentrate, assaying 70·3% metallic tin, were recovered; and the working profit was £23,946. An interim dividend of 25% was declared at the end of the quarter; and as prospects are encouraging it seems reasonable to expect the dividend for the current financial year to total 100 per cent.

The annual dinner of the Chemical, Metallurgical, and Mining Society was this year, for the first time, graced with the presence of ladies, an innovation which did much to promote the success of the function. The mayor, Mr. Norman Anstey, drew attention to the fact that in floating the municipal 5½ million loan in 1904, financiers in London assessed the life of the industry, for loan purposes, at 30 years. Deducting the years that have elapsed since then, the remaining life, according to the aforesaid financiers, works out at 20 years, a result somewhat different to the inflated estimates which have been let loose from time to time by prominent but prejudiced estimators. The president, Mr. Alex. Richardson, expressed himself as being out of sympathy with the flat contract system, and advocated the Kimberley formula: whites on day's pay and natives on contract. He also made the novel suggestion that it would pay the gold industry to dispatch one of its more experienced engineers to make a close personal study of the practices of other mining fields, in order that the first-hand information so gathered might be utilized in helping to solve any of the difficult problems with which we are confronted. At the annual dinner of the South African Institute of Electrical Engineers the Minister of Mines and Education, the Hon. F. S. Malan, referred to the legislation about to be introduced in Parliament for the purpose of preventing industrial disputes, and invited all sections of the community to depute delegates to interview him personally with regard to the measures of the Act. Col. Dalrymple recalled the reports of well known engineers who had occasion to investigate the possibilities of the goldfield in its early days, and whose conclusions were that the banket formation was a mere gravel patch, which might possibly extend to a depth of 60 or 100 feet!

The murderous attack on Sir Lionel Phillips by an uncontrolled kaffir storekeeper and money-lender of Polish birth has caused all decent citizens to view the present condition of affairs with something approaching alarm. The strike riots furnished quite enough disconcerting evidence that modern civilization is not all that it seems, without adding the attempted assassination of a highly respected townsman at the lunch-hour in busy Commissioner Street. The outrage originated in a fancied grievance nursed by the perpetrator against one of the mines belonging to the Central Mining—Rand Mines group, of which corporation Sir Lionel is the resident head. It seems to be becoming a fashionable obsession with misguided people who have even the remotest connection with mines to ascribe the adverse dispensations of fortune to the supposed machinations of those who control the mining industry. This is a course of reasoning which involves no apparent loss of self-esteem, and, therefore, one which commends itself to the half-baked logician in the street. When in trouble blame the Corner House, is a saying which appears to possess a soothing mental flavour for the ignorant. Events by this time should have proved that the financial hierarchs of the Rand are just as considerate and kindly as the average human being who has not yet sprouted a set of wings; and that they have earned their money, those who know what they have had to put up with freely admit. The position of head of a group is far from being a sinecure. Heaven lies about you in your infancy, and everybody lies about you when you are a mining magnate.

The outlook for 1914 exhibits few encouraging features. Native labour supply and white labour antagonism are problems that are no nearer solution, and oversea investors prefer to place their money elsewhere; the political horizon, too, is veiled in uncertainty. One mining group has already prepared for the worst by cutting one-third off the salaries of its head-office staff, a precedent which, no doubt, will be made use of by other firms. The highly successful advent of the Van Ryn Deep introduces a slight element of hope; and the fruitful efforts of Sir George Farrar to bring about the Kleinfontein-Apex-Benoni fusion, and the rapid on-coming of the State Mines and the Modder Deep, are consoling factors doing much to mitigate the prevailing apprehension.

NEW YORK.

The strike of the copper miners in the Lake Superior district, engineered by the Western Federation of Miners in the hope of forcing the operators to recognize that body, has held attention in other districts for that reason. The Western Federation stands for the nearest approach to Nihilism that we have in this country, the dominance of a large body of honest and hardworking, albeit more muscular than intellectual, men having been seized by vicious and unscrupulous men, of whom C. S. Moyer is the chief. After having perpetrated outrages, including dynamiting buildings and murdering operators, in Colorado and Utah, they were defeated by T. J. Grier and his associates in South Dakota in 1910 and again in 1912 in Utah and Nevada by D. C. Jackling. In July last they called a strike in the Lake Superior copper mines, ostensibly demanding an 8-hour day, the withdrawal of the one-man drill and various other things, but really to secure recognition of the union, staggering under two defeats. As a matter of fact, the Lake Superior operators are perfectly willing to grant an 8-hour day and to make all the minor changes asked. The one-man drill has decreased the cost of mining from 50 c. per ton to 15 c. and increased the amount of ore mined per drill-shift from 12 tons to 36. All the mines, excepting the Calumet & Hecla, are very low-grade and the copper content decreases in depth. The introduction of this drill has been the only thing that has enabled many of the mines to keep working in the face of increasing costs and diminishing returns. Thus, instead of decreasing the number of miners employed, as claimed by the union, it has been the means of preventing them from losing employment. The operators have certainly been at fault in refusing to deal with their employees except as individuals. As free men the employees certainly have the right to get together and select a man as their spokesman, and the miner is at an undue disadvantage when forced to speak only as an individual to a man who is vested with the authority of the corporation he represents. The obvious thing to do is to encourage the miners to form an organization that will stand for law and order and the securing of their reasonable rights, as was done at the Homestake three years ago, with excellent results. The obstinate objection to taking any such course shown by the officials of the mining companies exhibits a degree of ossacaputism which is not to their credit. As it stands now, there is little likelihood that anything like full production will be resumed before next spring. An element of the tragic was injected into the situation on December 24, when, at a Christmas celebration in the Italian Union Hall, at Redjacket, some fool raised a cry of fire. In the ensuing panic nearly 80 men, women, and children were crushed or trampled to death. Since all of the killed and injured belong to the families of strikers, Moyer at once tried to turn the disaster to his advantage by claiming that the panic was started by the agents of the mine owners. This action well exhibits the character of the man. When the miners rid themselves of the incubus of the leadership of this man and his like, they will be vastly the gainers.

The American Smelting & Refining Co., and its colleague, the American Smelters Securities Co., has had a poor year, the gross income being about 1,000,000 less than last year. Its operations in Mexico have only been at $\frac{3}{4}$ capacity during the first half of this year, and it is doubtful if they will exceed half that for the second half of this year, as Aguascalientes is the only Mexican plant that has been able to work more than a small part of the time. In addition, the Department of Justice of the United States has been going over the books of the company for many months past, in order to determine whether it is a combination in restraint of trade, in which case a suit will be brought against it to enforce its dissolution. No intimation has been made as to whether the suit will be brought, but it seems unlikely, as the policy of the Government seems to be to effect necessary reforms quietly, if possible, and there is no doubt that a large element in the starting of the Steel Corporation suit was its expected political effect. Incidentally, the same cause that chiefly affects the A. S. & R., namely, the disorganized state of transport in Mexico, is causing great difficulties to the National Railways of Mexico, and the lack of earnings causes much difficulty in meeting the interest on its securities.

Petroleum production in California for the year will amount to nearly if not quite 100,000,000 bbl. Detailed figures of gross production for the first 10 months of the year were as follows :

January 7,566,789	July..........8,427,081
February...7,207,198	August 8,812,793
March.......7,968,407	September..8,656,000
April 7,927,041	October 8,236,649
May.........8,049,715	———
June 8,030,111	Total.......80,896,784

On the whole the year has been a good one in the oilfields, though not one characterized by any dramatic bringing-in of new wells. Within the year the Shell-Royal Dutch have become seriously interested in the field and the General Petroleum Co. has been financed. These are undoubtedly the most significant events and they emphasize the fact that in California at least, oil production to be successful requires operation in large units. The new state law attempts to make pipe-lines common carriers, though it is difficult to conceive of the plan working to much advantage. It was anticipated that there would be a long controversy in the Courts over the matter but the Standard Oil Co. at least has announced acceptance of the principle. Late in December also the Standard came into the market again for heavy oils. While attempts have been made to connect the two announcements and cite them as evidence of some deeply laid plot, the better conclusion is that the Company finds it can buy and use heavy oil to advantage. At any rate its return to the buying field has been loudly welcomed.

Zinc producers, including smelter men as well as ore producers in the United States, found little for jubilation as 1913 drew to a close. It is true that preliminary figures indicated a record output of spelter, but what is production without profit? In 1912 the spelter output was 338,806 tons. In the first half of 1913, according to figures of the United States Geological Survey, it was 180,000 tons and the rate probably held good for the second half of the year. It seems clear, however, that stocks increased, perhaps as much as 50,000 tons and from November 1912 to November 1913, these shrank in value about $50 per ton. Unfortunately, too, the outlook for 1914 is not good. Zinc follows iron and steel closely, which is not surprising since, aside from the general affinity of metals in industry, 50% of the spelter produced in the United States is used for galvanizing. A slow market for steel wire and sheets necessarily implied a low demand for spelter. In addition tariff changes have complicated the situation. While the final effect of the revision of the schedules is not yet apparent, in that Mexico being disturbed ore from that country has not come into the market much, as it is sure to do later, it now appears that the margin of profit for the smelters has been increased by the changes. At present, however, they are working on practically no margin and only one new works was built in the year, that of the American Metal Co. near Pittsburgh. As usual the bulk of the ore used came from the Joplin district, which is estimated to have yielded 280,000 tons of blende and 22,000 tons of silicate. Wisconsin will show a considerable increase as will also Montana. The other Western states have about maintained their output. While much experimental work on leaching and thermo-electric processes of smelting has been under way, no announcement of commercial results has been made except by the Continuous Zinc Furnace Co., of Hartford, Connecticut. W. McA. Johnson, the metallurgist here, is so well satisfied with his results that a commercial plant in one of the Western states is planned.

Juneau is fast becoming one of the world's great centres of gold mining. The Treadwell group, with its production of 5000 tons per day, was followed last year by the new Alaska Gold Mines properties, at which is now being completed a 6000-ton plant, spoken of as the 'first unit.' North of the Perseverance, the principal property of the Alaska Gold Mines, lies the Alaska Juneau, a former Wernher Beit property. This is now owned by F. W. Bradley, Ogden Mills, J. H. Mackenzie, and others of the group so closely associated with the Bunker Hill & Sullivan, the Treadwell, and other monuments to good engineering and business in mining. A deep level adit has been driven from Juneau back into the mountains undercutting the old workings, and comprehensive plans for future working were announced by Mr. Bradley in the *Mining and Scientific Press* for December 6. A pilot plant of 30 stamps will soon be ready for operation and a series of four units each of 3000-ton capacity per day are planned. Estimates are based upon a recovery of $1·45 per ton at a cost of 80 c. when working on a 6000-ton basis. It is expected that 100 tons per machine shift can be broken and a system of mining is planned which, it is expected, will require but slight expense for 'bulldozing,' one of the large items at Treadwell. Immediately north of the Juneau, and on a continuation of the same lode, is the Ebner, a similar but less thoroughly prospected property upon which the United States S. R. & M. Co. has taken a lease and bond. An adit is being driven to prospect this property at depth and a third great mine may be expected.

DISCUSSION

Sericite and Kaolinite.

The Editor:

Sir—In the excerpt from Mr. J. F. Kemp's interesting paper on artificial vein formation at the Tomboy mine, given in the Magazine for November (page 380) 'sericite' and 'kaolinite' are said to have been found in the concentrate. I have seen similar associations referred to in many other papers of late. I should be glad to know how these minerals can be distinguished from each other when occurring together. I have had a good deal to do with both minerals, but I do not know how to distinguish one from the other when they are supposed to occur in mutual association. Perhaps some of your readers can inform me.

J. H. COLLINS.

London, November 20.

The Editor:

Sir — Most workers with the microscope have been worried by the difficulty mentioned by Mr. J. H. Collins; for small scales of the sericitic mica and kaolinite, which are so frequently associated with one another, have apparently been in collusion in adopting similar crystal-habits, in arranging both to be negative in their sign of double refraction, and in approaching one another most inconveniently in specific gravity and in average (I avoid the usual word, mean) refractive index.

But when the scales are sufficiently thick (say 0·03–0·05 mm.) the stronger double refraction of the mica shows up by higher polarization colours between crossed Nicols. Thus, while some of the scales in these 'clay' products can be distinguished from one another, the smaller fragments cannot always be separated with certainty under the microscope.

Dr. George Hickling (*Trans. Inst. Min. Eng.*, XXXVI, 1909, pp. 10–33) found that practically all the material in an ordinary Cornish china-clay will affect polarized light if examined with high powers, and that the finer material, in which it is impossible to discriminate between the mica and kaolinite scales, is still mainly a mixture of these two species. His results are based on (1) the definite identification of the sufficiently large scales by the strength of their double refraction, and (2) the fact that a bulk analysis of a good sample of china-clay satisfies the equation

$$x \times \text{Kaolinite} + y \times \text{Mica} + z \times \text{Quartz} = \text{nearly } 100.$$

He finds this possible only by adopting for the composition of kaolinite the formula, $Al_2O_3, 2\,SiO_2, 2\,H_2O$, instead of that proposed by Mr. Collins in his well known paper in the *Mineralogical Magazine* (Vol. VII, pp. 205-214), namely, $Al_2H_6O_6SiO_2$, $Al_2O_33SiO_2$, that is, $2\,Al_2O_3$, $4\,SiO_2$, $3\,H_2O$. Perhaps Mr. Collins will now accept the more usually adopted formula, as his analyses of china-clay were made when its composite mineralogical nature had not been so clearly established by microscopic examination.

THOMAS H. HOLLAND.

Alderley Edge, December 1.

The Editor:

Sir—Since sericite and kaolinite are both produced by the alteration of orthoclase felspar, the former resulting from the partial removal of the alkali, the latter from its complete removal, their occurrence in intimate association in such rocks as altered granites is only what might be expected, and is probably very common.

To distinguish the one from the other in such cases is usually difficult; it is often impossible without recourse to separation and chemical analysis, and since isolation of pure material in sufficient quantity for complete analysis may not be possible, even this test is sometimes inapplicable. If minute quantities of pure material can be obtained, a microchemical test for potassium will often serve to distinguish sericite from kaolinite, and this is perhaps the best method of differentiation. In favourable cases the distinction may be made by optical tests. Cleavage or crystal flakes of sericite, which are usually coarser than those of kaolinite, give a bi-axial interference figure with 'eyes' apart, the centre of the figure coinciding with the intersection of the cross-wires in the microscope field. In kaolinite the axial angle is usually very small, and the 'eyes' are consequently near together. The acute bisectrix is not normal to the basal cleavage of the flake, and therefore the centre of the figure does not coincide with the centre of the field. Further, in rock sections, sericite shows the bright polarization colours of a strongly birefringent muscovite, whereas kaolinite, if sufficiently crystalline for polarization colours, shows the low-order greys and white of a weakly birefringent mineral. But these optical tests, though sound in theory, often give in practice, as every worker knows, results that are indefinite and indecisive. In unfavourable cases, where neither chemical nor optical tests can be readily applied, the distinction of the two minerals from one another, where occurring admixed, is a matter of the greatest difficulty. A bulk analysis may lead to the inference that both are present, but the location of the particles of each in the mixture may be quite impossible.

C. G. CULLIS.

South Kensington, December 1.

Ore.

The Editor:

Sir—I am sorry not to be able to support Mr. McCarthy in his definition of ore, as given in the November issue of *The Mining Magazine*. It appears to me to err somewhat on the side of comprehensiveness. Substitute 'mineral' for 'ore,' and I think his definition might stand.

As brevity is the soul of a good definition, I would describe ore as 'any metalliferous mineral which is or can be mined or quarried.' In the miner's use of the word, ore is the exact equivalent of *Erz* in German. Karl Selbach, in his valuable *Illustriertes Handlexikon des Bergwesens*' (1907) defines a metalliferous mineral as one from which a heavy metal can be extracted, which is called *Erz* (ore) when it is the object of mining production ('*Gegenstand bergmännischer Gewinnung*'), which is the same definition as that given above, but expressed differently.

I agree with Mr. McCarthy that an ore remains an ore, whether worked at a profit or otherwise. Thus: galena is an ore of lead wherever and whenever it occurs. It does not cease to be an ore of lead because it cannot be mined at a profit in any particular mine or locality, for it is actually being mined at a profit in many mines or places elsewhere. But there are a few metalliferous minerals which are ores only in one locality, e.g., livingstonite ($2\ Sb_2S_3\ HgS$) is mined only at Huitzuco, in the state of Guerrero, Mexico, and patronite (vanadium sulphide) is mined only at Minasragra, in the Cerro de Pasco district, Peru. These minerals are ores in their respective localities—elsewhere they are rare minerals.

I would include native metals, as gold, silver and copper, with or without gangue, among ores, as they occur in workable deposits, and mining and metallurgical methods are necessary to extract them and convert them into merchantable metal. This brings one to the original meaning of 'ore.' In Vol. VII of the New English dictionary (Oxford, 1909) the word is derived from old English *óra*, unwrought metal, or *ár* brass. "The modified English word appears to derive its sense from O. E. *óra*, but its form from O. E. *ár* brass, which may have been extended to the sense 'metal,' and thus to 'ore.'" Hence the etymology of the word justifies one in describing any native metal, which occurs in sufficient quantity to be mined, as 'ore.' The second meaning of the word, given in the New English dictionary, is "Metal, especially precious metal, chiefly poetic." Thus Milton, in 'Lycidas':

> "So sinks the day-star in the ocean bed,
> And yet anon repairs his drooping head
> And tricks his beams, and with new-spangled ore
> Flames in the forehead of the morning sky."

Here 'ore' means 'rays of golden light.'

The Germans call minerals of organic origin, coal, amber, and the like, *Fossilien*, not *Mineralien*, and at one time 'fossil' in English meant anything dug out of the earth (latin *fossum*, to dig), but that meaning of the word has long fallen into desuetude.

A passing reference should be made to the meaning of 'ore' in the mineralogical sense: "A mineral compound in which a metal is a prominent constituent" (James D. Dana), but this definition does not satisfy the miner; his ore must be workable, or he regards it as so much 'rock.' One must draw the line somewhere. Quartz, containing only a very few pennyweights of gold to the ton, may, possibly, be regarded as an ore, as it is or can be mined at a profit in a few happy localities, but quartz containing only a few grains of gold per ton is not an ore, for it is workable and profitable nowhere at present, and one can only call it 'quartz' with indications of gold.

EDWARD HALSE.

Twickenham, December 2.

The Editor:

Sir—In reply to your request for a definition of 'Ore,' the movement of the last few years has been toward greater simplicity of description, and any further changes, to be progressive, should be in the same direction.

The mining engineer has to consider the commercial aspect equally with the scientific side of the question, and should couch his language in terms that are, without further explanation, obvious to the lay shareholder. With this point in view the following standard definitions appear to me to cover the ground:

'Mineral': Any native substance that is mined or quarried.

'Ore': Mineral, or rock, from which a substance of economic value can be extracted with profit.

Ore reserves can only legitimately include ore capable of being estimated that is actually profitable to work at the time of estimation.

If the words 'with profit' were to be omitted from the definition of 'ore' then the word 'profitable' would need to be inserted before 'ore reserves.' As simplicity in statements of ore reserves is the prime objective, it is preferable to leave the restriction attached to the 'ore' classification.

With regard to the various sub-headings of 'ore reserves,' the rules laid down by the Institution of Mining and Metallurgy, Vol. XX, page 526, cover the whole range of statements of fact and prophetic estimate. The classification therein set forth would only be complicated by further elaboration.

HUGH F. MARRIOTT.

London, December 6.

The Editor:

Sir—In the following I have endeavoured to give an answer to the question contained in your letter of the 24th ultimo.

I should say 'ore' is generally understood to mean a mineral substance, in which some valuable metal is contained in sufficient quantity to be worth extracting. When speaking in general terms, the use of the word implies that the contained metal is present in a proportion or percentage that has been treated successfully somewhere. When speaking specifically of an ore at some particular locality, I should say that the use of the term implies that it contains enough metal to make it worth working in that locality.

To my mind the expression 'unpayable ore' is rather a contradiction in terms, which is sometimes misleading.

While the term 'ore' usually implies the presence of some metal, this is not invariably so, as in the case of sulphur, where the mineral containing this non-metallic substance is spoken of as sulphur ore.

WM. FRECHEVILLE.

London, December 5, 1913.

The Editor:

Sir—My conception of the meaning of the term is:

"Ore is that portion of a mineral deposit distinguished from its enclosing rocks in that it contains minerals or metals in such quantity as to permit of their profitable extraction."

Custom has endeavoured to broaden the interpretation of the term to cover combinations of minerals which present the same physical features as the ore proper, but which fail to possess the chief attribute of 'profit.'

If the term 'ore' is to be used only in its most legitimate sense, then it would be advisable perhaps to devise some recognized form of description for those other portions of a mineral deposit which vary in constitution from the enclosing rocks, but which cannot be profitably treated.

H. S. DENNY.

London, January 2.

Rio Tinto.

The Editor:

Sir—As an old Rio Tinto employee, I very much object to the general tone of the article, under Special Correspondence, in your November issue, dated from Huelva. My objection to the article is the fact that your correspondent implies that a great deal of the presumed "sentimental element" that has been injected into the recent strike at Rio Tinto is due to the attitude of the subaltern members (as your correspondent calls them) of the English staff toward the native population.

As far back as twenty years ago it was well known in Rio Tinto that no member of the junior staff could mingle with the Spaniards if he had any hopes of advancement. To marry a Spanish lady practically meant isolation, and the career of the official was—so far as advancement with the Company was concerned—for ever damned. If the strike, therefore, was in any way connected with the fact that the English staff does not mingle with the Spaniards, the blame cannot rightly be placed on them, as undoubtedly it was not lack of desire on the part of the junior officials to mingle with, and take part in, the Spanish life at Rio Tinto, but the knowledge of the attitude assumed by the management toward any such association. That the management is probably correct in the view it takes on the subject is brought out by your own correspondent in the same article where he mentions "the other grievance," which was a grievance many years ago, and will probably continue to be one as long as Spaniards have their peculiar ideas of honour and morality. To give his superior a present, or 'backsheesh,' as your correspondent calls it, is a Spanish trait in which neither the giver nor the receiver considers there is any particular wrong, although it is well known to both that the giver expects something in return; which, at Rio Tinto, of course, means promotion of some kind. In insisting that the junior members of the staff keep to themselves and not mingle with the Spaniards, the company probably has this trait in mind, and the fact that by not associating they are less liable to become contaminated with Spanish ideas.

My position at Rio Tinto—as chief chemist—did not call for my coming in contact with the Spaniards in a business way, and this, with the further fact that I am familiar with the Spanish language, allowed me to mingle with Spaniards a good deal more than other members of the staff, and I could do so without comment.

From my own observations while at Rio Tinto, and many years experience in other parts of the world, I do not think the Rio Tinto management is wrong in keeping its English staff separate as much as possible from the Spanish population; but do not saddle the *caballero sin caballo* with the responsibility of his mental attitude to the Spanish population.

J. W. Bennie.

Clifton, Arizona, Dec. 2.

[We are glad to publish Mr. Bennie's letter. Certainly, it is inadvisable for the junior members of the staff to be 'thick with' the native population, but it is not necessary to inter-marry with the Spaniards in order to be considerate or kindly. It is as unnecessary for a young engineer to behave so ignorantly toward them as it is for him to assume, with a native wife, the support of an entire family. —Editor.]

The Editor:

Sir—As a former chief of department at Rio Rinto, with supervision of some 4000 workmen, I was not a little surprised at some of the remarks of your Huelva correspondent in the November and December issues.

By direct statement and innuendo the impression is conveyed that the management, administration, and staff generally, are:

(1). Arrogant, unsympathetic, and unjust towards the Spanish workmen and the native population in general, and that

(2). Bribery flourishes between the English staff and the native workmen.

Although possibly conversant with the general conditions at Rio Tinto, your correspondent shows a singular lack of perception when he groups the staff, including chiefs of departments, with the management and administration.

I hold no brief for either, but must express strong disagreement at his unfair and sweeping attack on the mining staff.

As a whole, the mining staff at Rio Tinto are a conscientious, hard-working body of men and though general and inter-departmental efficiency is no doubt seriously affected by causes pointed out in your November leader, individual engineers attend more unselfishly to duty there than at many other mines. Painstaking effort and self-sacrifice, without expectation of thanks, are a traditional characteristic of engineers at Rio Tinto, which has been exemplified often in times of crisis and recently in such a tragic manner at San Dionisio.

There is at Rio Tinto as much personal intercourse and fair dealing between the mining staff and the native employees as at other large mines operated by English companies in foreign or even in English-speaking countries.

The attempt to give directions *in persona* would be as absurd as impracticable in such immense operations as are conducted at these mines, where in such large workings as the South Lode or San Dionisio it is a matter of days to simply visit all the working places.

Orders are given there as at any other well conducted mine, that is, through the *capataces* (foremen), and *encargados* (sub-foremen), with whom it is the custom to discuss fully questions of minor policy, and with whom the staff concerned are in sympathy.

It was, and I believe is still, the invariable practice for chiefs to investigate fully *all* complaints, and those which come under their jurisdiction are promptly and equitably settled to the best of their ability, in so far as their powers allow.

A large proportion of complaints concern housing and other questions, which must by order be referred to the general manager, and, if not always decided quickly, or in the opinion of the complainant, fairly, the fault does not lie with the member of the staff concerned.

In Rio Tinto, as in other countries where a foreign language is used, it is not natural to expect new comers to assimilate the customs and language at once, and even when these are acquired the educated and better class Spaniard is somewhat of a *rara avis* at the mines. At Huelva it is different, and there the relations between this class and the older residents among the English staff are as cordial as in any other Spanish or Spanish-American community under like conditions. Indeed, there are some Spanish families with whom it would be difficult for members of the English staff to become acquainted, and who as in England, require proper social introductions before admitting strangers to the intimacy of their households.

As regards the desirability of the English staff mixing socially with the ordinary mining population, discussion is hardly necessary. One may find their English equivalent among the workmen's dwellings of any South Wales or Yorkshire colliery town.

Touching the question of bribery between the staff and Spanish workmen, old rumour has it that cases did occur among certain Cornishmen occupying subordinate positions years ago. It has not been the practice in modern times. If a case does occur it must be kept secret, and certainly the members of the superior staff are not concerned, as might be implied from your correspondent's letter.

All former Rio Tinto engineers with whom I have spoken on this subject agree that the imputations on their judgment and conduct are unmerited and unfair. In conclusion, I would say to your correspondent "*Entiende primero y habla postrero*."

D'ARCY WEATHERBE.

London, January 3.

The Editor:

Sir—In an article on Rio Tinto in your last number some rather sweeping assertions were made by a correspondent writing from Huelva regarding the attitude of the English staff toward the Spanish employees and workmen. It was made clear that in the opinion of this Huelva authority the present labour unrest at Rio Tinto was largely to be ascribed to the unsympathetic attitude of the English chiefs of departments toward their Spanish workmen, that the Englishman in authority was a mediæval tyrant against whose autocratic decisions the poor downtrodden Spanish workman had no redress. May I, as one whose association with Rio Tinto extends to some years and who may claim intimate knowledge with the relations which exist between the men and their immediate executive chiefs, venture to suggest that your correspondent has fallen into the too frequent error of judging a body of men by the shortcomings of a few isolated examples. My experience with workmen extends to a good many parts of the globe and, while admitting that in some instances the Rio Tinto Company is not sufficiently careful in selecting the right type of men to put in authority over the Spaniards, I can confidently say that on the whole the relations between masters and men are far more cordial and sympathetic than is usually possible without loss of prestige and authority, and that the cause of the present dissatisfaction and disregard for order and discipline must be sought in other directions than among those in immediate control of the departments.

C. H. SALMON.

Westminster, January 6.

Great Cobar.

The Editor:

Sir—From the space which you devoted in your last issue to the recent agitation against the Great Cobar directorate, it is evident that you regard the matter as one of considerable public interest. I therefore venture to address a few remarks to you on the subject, believing that the lesson involved is well worthy of study.

I need not recapitulate the causes which led up to the agitation. They must be obvious to any of your readers who have followed the career of the Great Cobar company. It is sufficient to say that, to myself and my friends, the circumstances appeared to render reform in the methods of management absolutely essential unless our heavy stake already in jeopardy was not to be irretrievably lost. As the stake in question represented over ten thousand shares of £5 each, it was worth fighting for.

The futility of a shareholder's protest on the only occasion when he is officially invited to express his views, namely at the annual meeting, will, I think, be admitted by almost every one who has ever attended such a meeting. So futile, indeed, have protests of this kind come to be regarded, that it is no exaggeration to say that the shareholder who opposes the directors on such occasions incurs, as a rule, not the credit which he unquestionably deserves for his foolhardy courage, but the mild derision of his audience.

In the Great Cobar case, we resolved upon a different, though more expensive, line of action. As you are aware, Mr. F. Kimber Bull, whose professional assistance in the matter I had asked, and I, invited the shareholders to meet us informally at the Cannon Street hotel. Though for obvious reasons we did not definitely include the directors in our invitation, we sent them a copy of the circular calling the meeting, and at least one of them came. The meeting was largely attended and expressed itself unanimously and enthusiastically in favour of the course which we were taking, a committee being appointed to invite proxies from the shareholders and to formulate a plan of action to be followed at the forthcoming annual meeting.

So far all was well, but our troubles were now about to begin. In the first place, we did not know the date on which the annual meeting was to be held, and a letter asking for this information was ignored by the Board. Our first intimation of the date of the meeting was on Tuesday the 9th December, when we learned from the directors' report that it would be held on Wednesday, the 17th. This choice of a Wednesday, though I am assured it was not premeditated, constituted the first snag upon which we stumbled. By the Articles of Association of the Great Cobar company, proxies, in order to be effective, must be lodged at least two clear days before the meeting. In other words, our proxies had to be at the Company's office not later than Sunday night; and as Sunday is a *dies non* and Saturday only half a day in the City, it meant that we had only four days, from Tuesday to Saturday, in which to solicit and obtain proxies not only from the English but also from the Continental shareholders.

The Shareholders' Committee received 361 proxies, representing 37,545 shares, which was equivalent to more than a third of the total registered shareholders and to nearly a third of the total registered shares of the Company. Considering the apathy of the average shareholder where proxies are concerned, and the probability that many, finding it impossible to lodge proxies by the specified date, refrained from voting, this was highly satisfactory, and we looked like winning the day.

This brings me to the next stage of the story. At the annual meeting there is no doubt that the majority of those present were friends of the directors. This was perhaps to have been expected in view of the large number of proxies sent to the Shareholders' Committee. The usual sort of oratory was indulged in, and eventually, on a rather half-hearted show of something under twenty hands (later described in one of the directors' circulars as an overwhelming majority), the proposals of the Shareholders' Committee that Mr. Kimber Bull and I should be elected in place of two of the retiring directors, were defeated. A poll was, however, demanded.

By the Articles of the company, which do not differ very materially from those of most mining companies, the Chairman is omnipotent when it comes to a poll. He decides where, when, and how it is to be held, and the questions which are to be put to the vote. In the present case he decided not to hold the poll at once, but to postpone it for 13 days, until the 30th December. This was no doubt because the proxies lodged by the Shareholders' Committee so far outnumbered those in favour of the directors as to render the defeat of the latter probable in spite of the friendly majority which was present in the room. The Chairman either by design or accident also arranged that the poll should not be on the straight issue as to which two of the four names proposed should be elected directors, but he pitted Mr. Kimber Bull against himself, and myself against Mr. Barnett, the other retiring director. I can state with certainty that this feature was not understood by many shareholders, though the effect was of great importance, namely, that a shareholder voting for the Chairman could not vote for Mr. Kimber Bull, and a shareholder voting for Mr. Barnett could not vote for myself, without nullifying his vote. The result was that several shareholders voted for only one director instead of two, and some withheld their votes altogether.

The postponement of the poll was the undoing of the Shareholders' Committee, as it was intended to be. The delay gave the Board 15 days between the date of the deposit of the proxies and the poll in which to canvass the Committee's supporters, and obtain revocations of their proxies. The result was the withdrawal of about 4500 of our 37,545 votes. I submit that this part of the proceedings was unfair to the Committee. The unevenness of the contest will be obvious when I recapitulate that:

The Committee had four days in which to obtain proxies; then, after the names and addresses of their supporters had been submitted to the Board, the latter had 15 days in which to canvass for withdrawals.

The Board had two days longer than the Committee in which to obtain proxies, while there were no means by which the Committee could obtain the names of the directors' supporters for canvassing purposes.

I have been criticized for having allowed my name to be put forward by the Shareholders' Committee, after having stated at the informal meeting at the Cannon Street hotel that neither I nor Mr. Kimber Bull had any desire to become a director. Somewhat cynical reference has been made to the "spoils of war" and so on. I venture to say that a directorship of the Great Cobar company brings with it no "spoils of war." All there was to be got has already been had. The directors have not drawn fees for many months past and should not do so for many months to come, if ever. The position is a bed of thorns, not of roses. I took the view at first, not having then appreciated as I do now these truths, that the fact of my having originated the agitation prohibited me from benefiting by it, although it would have been natural, having gone to so much trouble and expense as I had done, that I should wish to be in a position where I could effectually further the policy which I wished to see carried out. In the end, after consultation with my friends, I decided, rightly or wrongly, that the fact of my having originated the agitation, so far from preventing me from allowing my name to be put forward, left me no alternative but to see the business through to the end. It was at my request, backed up by the Shareholders' Committee, that Mr. Kimber Bull consented to be put forward, and I am convinced that his business ability would have been of infinite service to the Board.

In writing this letter I have tried to avoid pettiness, but I have been speaking from the point of view of the dissatisfied shareholder, and if I have entered into what may seem trivial details, it has been because I think that my experience may be of value to others, who, like myself in the present case, are not content to stand by helplessly, praying and hoping for miracles to happen, while they anxiously watch a board of directors in whom they have lost confidence, bungling their business and dissipating their capital.

The moral of my story is, perhaps, that if you are unfortunate enough to lose your money, even though bad management may be the cause, it is politic to accept the fact and make the best of it. It is foolhardy to attack your Board. They are too strongly entrenched. Besides, it is wise to remember that they have the free run of the shareholders' money for conducting their campaign, so that you are actually paying part of their costs, while you have the whole of your own to pay as well.

The stock argument which was used by the directors in the present instance, that by agitating for reform you are running the risk of wrecking the company, should carry no weight at all. The line of thought appears to be that while it is wrong to wreck a company suddenly, it is quite right to leave the directors to wreck it gradually, and at their convenience.

As you are aware, we lost at the poll last Tuesday. The 37,545 proxies with which we started were whittled down to about 24,000, through withdrawals, informalities in signatures, and one thing and another, but principally by a large number having been shut out through their arrival after the specified time.

After the result of the poll was known, one kind shareholder wrote to me and said that "some failures are equal to triumphs, and I think this is one." Grateful though I felt, I could not conscientiously say that I agreed, but if, as I think is the case, our action has proved to the directors that a large number of the shareholders are dissatisfied with the present position, and that there is room for improvement in the method of management, I shall feel that we have not fought in vain.

ROWLAND C. FEILDING.

London, January 5.

Machinery for Flotation Processes.

The Editor:

Sir—Our attention has been called to the following statement in the speech of the chairman of the Minerals Separatoni, Limited: "The plant was built for the Falcon Mines of Rhodesia to our designs by Messrs. Fraser and Chalmers of Erith, London, who, as you are probably aware, have hitherto built their special plants and apparatus for Messrs. Elmore's, the Ore Concentration Company (1905), Limited."

As it is possible that this might be mistaken by some of your readers as meaning that we are no longer manufacturing the plant of the Ore Concentration Company (1905), Limited, we beg to say that we are still licensed to make the machinery for that company's processes, and have only lately shipped three plants for the treatment of copper ores at different mines.

FRASER AND CHALMERS, LIMITED,

F. GURDON PALIN, Secretary.

December 31, 1913.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

Dec. 1913	Nov. 1913	Dec. 1912.
£65. 5s. 7d.	£68. 8s. 9d.	£75. 12s. 2d.

Average for the year £68. 5s. 8d.

The substantial increase in the world's stocks at the end of November has been followed quite naturally by declining prices for the metal. Demand for the time of year must be considered satisfactory. It has been spasmodic, with bursts of a few days activity, followed by long spells of idleness. There has been no continued confidence to give rise to a concerted buying movement such as was generally anticipated a few weeks back, the course of political events in the New World having retarded its development. American producers have sold heavily to Europe at 14 c. and upward for delivery up to March, and the standard market was favourably affected by the news. The effect, however, has not been lasting, the unsettled general outlook having made consumers wary. To American buyers sales have been light; 15 c. was at one time realized, but this proved to be the top of the market. As we write news comes to hand of a fresh strike at the Rio Tinto mine; the railway and pier seem to be unaffected. Prospects for 1914 are not unfavourable, the money market seems to be approaching easier conditions, and there are hopes of a reawakening confidence.

TIN.

Average prices of cash standard tin:

Dec. 1913	Nov. 1913	Dec. 1912.
£171. 18s. 11d.	£181. 0s. 0d.	£226. 17s. 8d.

Average for the year £201. 14s.

The market continues to fall steadily. Prices have declined from £180 to £169 with scarce a rally. In spite of the efforts of a syndicate to raise prices, no general confidence in a higher level is apparent. Indeed, with an increased production and decreased consumption, operators are naturally shy of embarking on a bull campaign. There have been free predictions of the decline continuing to £150. It may safely be surmised that the recovery will be rapid and complete. The truth is that this metal is too much under the domination of manipulators, and much harm is done both to producers and consumers by their vagaries. During the last week of the year an active business was done both on the Metal Exchange and with Eastern shippers, but consumers were inactive. Their intervention may be anticipated shortly, for the tinplate trade seems in better shape since the accumulations at Swansea at the end of October have been relieved.

LEAD.

Average prices of soft foreign lead:

Dec. 1913	Nov. 1913	Dec. 1912.
£17. 8s. 8d.	£18. 13s. 9d.	£18. 1s. 6d.

Average for the year £18. 6s. 2d.

Demand has been better than is usual in December, as in anticipation of the annual stocktaking stocks at consumers works have been kept light. With the return of demand in January higher prices may be anticipated. The demand for lead throughout 1913 has been satisfied with difficulty, and the difficulty of obtaining adequate supplies during the coming year will probably be no less. With Mexican supplies cut off, reliance has to be put upon Spain to adjust the balance, and there appears grave doubt as to her resources being equal to the demand upon them. Arrivals in December have been on a rather liberal scale, but nevertheless good prices have been paid for prompt delivery.

SPELTER.

Average prices of good ordinary brands:

Dec. 1913	Nov. 1913	Dec. 1912.
£21. 6s. 5d.	£20. 14s. 4d.	£26. 0s. 4d.

Average price for the year £22. 14s. 3d.

The price of this metal shows a rise of about 15s. The renewal of the international spelter syndicate, following the renewal of the German syndicate, has given the market a fillip, and business has been active. The formation of an association among galvanized-sheet makers will no doubt give further confidence and help the market.

OTHER METALS AND MINERALS.

Prices quoted on January 10:

SILVER.—26½d. per oz.

PLATINUM.—185s. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£81 to £83 per ton.

NICKEL.—£170 per ton.

ANTIMONY.—£29 to £30 per ton.

ARSENIC, WHITE.—£13. 10s. per ton.

QUICKSILVER.—£7. 10s. per flask.

MANGANESE ORE.—9d. to 10½d. per unit.

IRON ORE. — Cumberland hematite 21s. per ton at mine. Spanish 19s. delivered.

PIG IRON.—Cleveland 50s. 6d. per ton. Hematite 61s. 3d. per ton.

WOLFRAM ORE.—33s. per unit (1%).

QUOTATIONS

of leading mining shares on the London Market.
Shares are £1 par value except where otherwise noted.
Quotations are given in shillings.

GOLD, SILVER, DIAMONDS:	Jan. 2 1913	Dec. 1 1913	Jan. 2 1914
RAND:			
Bantjes	25	13	14
Brakpan	86	46	48
Central Mining (£12)	206	147	152
Cinderella	23	3	5
City & Suburban (£4)	46	48	47
City Deep	63	52	52
Consolidated Gold Fields	66	40	42
Consolidated Langlaagte	28	30	30
Consolidated Main Reef	20	16	18
Crown Mines (10s.)	142	122	125
Durban Roodepoort	20	17	16
D. Roodepoort Deep	23	17	17
East Rand Proprietary	56	39	40
Ferreira Deep	67	46	47
Geduld	23	21	21
Geldenhuis Deep	26	22	23
Heriot	77	60	52
Jupiter	13	3	5
Kleinfontein	21	22	21
Knight Central	13	7	7
Knight's Deep	45	27	30
Langlaagte Estates	31	20	18
Luipaard's Vlei	10	9	9
Main Reef West	19	7	6
Meyer & Charlton	108	102	107
Modderfontein B	74	78	82
Modderfontein, New (£4)	248	225	232
Nourse	38	27	31
Primrose	42	30	33
Rand Mines (5s.)	134	109	112
Randfontein Central	27	22	21
Robinson (£5)	72	55	53
Robinson Deep	45	28	30
Rose Deep	61	45	47
Simmer & Jack	20	10	11
Simmer Deep	3	1	2
Springs	16	11	11
Van Ryn	80	65	71
Van Ryn Deep	20	34	35
Village Deep	42	35	35
Village Main Reef	51	36	37
Witwatersrand (Knight's)	65	67	72
Witwatersrand Deep	53	55	57
Wolhuter	18	13	12
RHODESIA:			
Cam & Motor	38	28	27
Chartered	27	19	18
Eileen Alannah	13	12	12
Eldorado	35	14	13
Enterprise	19	12	13
Falcon	29	17	15
Giant	31	13	15
Globe & Phœnix (5s.)	32	26	26
Lonely Reef	56	46	43
Shamva	65	38	36
Wanderer (5s.)	2	1	1
Willoughby's (10s.)	12	7	7
OTHERS IN SOUTH AFRICA:			
De Beers (£2 10s.)	430	351	353
Glynn's Lydenburg	23	13	12
Jagersfontein	143	102	105
Premier Diamond (2s. 6d.)	248	195	190
Sheba (5s.)	5	5	5
Transvaal Gold Mining Estates	52	48	48
WEST AFRICA:			
Abbontiakoon (10s.)	6	5	7
Abosso	22	15	17
Ashanti (4s.)	21	17	17
Broomassie (10s.)	8	5	6
Prestea Block A	20	13	14
Taquah	16	14	17
WEST AUSTRALIA:			
Associated Gold Mines	7	7	8
Associated Northern Blocks	6	13	10
Bullfinch	13	11	10
Golden Horse-Shoe (£5)	41	53	52
Great Boulder Proprietary (2s.)	12	13	13
Great Boulder Perseverance	2	1	2
Great Fingall	11	13	14
Ivanhoe (£5)	70	55	58
Kalgurli	43	32	37
Sons of Gwalia	21	23	22
Yuanmi	10	6	5

	Jan. 2 1913	Dec. 1 1913	Jan. 2 1914
OTHERS IN AUSTRALASIA:			
Blackwater	22	19	20
Consolidated Gold Fields of N.Z.	13	11	14
Mount Boppy	25	16	16
Mount Morgan	65	65	63
Progress	7	7	9
Talisman	35	42	42
Tasmania Gold (10s.)	1	1	½
Waihi	32	55	52
Waihi Grand Junction	22	26	25
AMERICA:			
Alaska Treadwell (£5)	177	157	155
Buena Tierra	20	16	16
Butters Salvador	43	37	35
Camp Bird	23	14	11
El Oro	17	14	13
Esperanza	38	20	19
Granville	14	10	10
Mexico Mines of El Oro	140	102	95
Oroville Dredging	7	11	15
St. John del Rey	16	16	15
Santa Gertrudis	30	17	16
Stratton's Independence (2s. 6d.)	2	1	½
Tomboy	27	27	25
RUSSIA:			
Lena Goldfields	62	40	37
Orsk Priority	20	6	6
Russo-Asiatic	—	46	72
Siberian Proprietary	10	2	2
INDIA:			
Champion Reef (2s. 6d.)	12	10	10
Mysore (10s.)	108	97	97
Nundydroog (10s.)	27	26	27
Ooregum (10s.)	17	22	21
COPPER:			
Anaconda (£5)	170	137	145
Arizona (5s.)	42	36	37
Cape Copper (£2)	152	102	95
Chillagoe (10s.)	3	1	1
Cordoba (5s.)	7	7	7
Great Cobar (£5)	90	17	16
Great Fitzroy (5s.)	1	2	3
Hampden Cloncurry	52	36	34
Kyshtim	62	60	60
Messina (5s.)	22	30	30
Mount Elliott (£5)	160	80	68
Mount Lyell	24	25	23
Rio Tinto (£5)	1510	1425	1370
South American Copper (2s.)	33	32	28
Spassky	85	56	53
Tanganyika	52	38	37
Tharsis (£2)	125	140	137
Whim Well	23	10	10
LEAD-ZINC:			
BROKEN HILL:			
Amalgamated Zinc	36	26	27
British Broken Hill	50	36	34
Broken Hill Proprietary (8s.)	44	33	35
Broken Hill Block 10 (£10)	38	33	31
Broken Hill Block 14 (25s.)	9	7	7
Broken Hill North	52	50	51
Broken Hill South	160	146	143
Sulphide Corporation (15s.)	32	24	22
Zinc Corporation (10s.)	17	17	17
TIN:			
NIGERIA:			
Abu (5s.)	—	10	10
Bisichi	25	16	14
Jos (5s.)	7	7	7
Kaduna (5s.)	25	15	15
Naraguta	27	33	30
Nigerian Tin	26	18	18
N. Nigeria Bauchi (10s.)	4	3	3
Rayfield	16	11	10
Ropp	58	127	122
OTHER COUNTRIES:			
Aramayo Francke	31	33	33
Briseis	9	6	6
Cornwall Tailings	33	17	17
Dolcoath	24	17	16
Geevor (10s.)	17	12	10
Gopeng	32	28	27
Mawchi	26	20	20
Pahang Consolidated (5s.)	11	10	10
Renong Dredging	—	40	40
Rooiberg	35	28	26
Tekka	70	62	60
Tronoh	76	42	35

TRANSPORT ON THE WEST COAST OF SUMATRA

By F. CLOSE.

A COMPANY was formed to develop gold-bearing quartz veins situated about 120 miles from the nearest port on the West Coast of Sumatra. A government road passes within 7 miles of the prospect as the crow flies; this road is well engineered and kept in fairly good order, every Malay being compelled by the Dutch government to work 52 days per annum on roads and other public works without pay, or procure a substitute to work for him.

The transport of machinery, etc., from rail-head to the point of the Government road nearest to the mine, a distance of 54 miles, was easily arranged through big native contractors, at a cost of 25s. per ton for pieces under 800 lb. weight, but the rate had to be increased for pieces exceeding this weight.

Two-wheeled country carts pulled by water buffaloes were used, a slow but sure conveyance; these would normally take from 1000 to 1100 lb., but some of them could be used for weights up to a ton in case of necessity.

To make a survey for a road in such country is a lengthy business owing to the impossibility of seeing the lie of the land ahead through the dense jungle. Government maps, scale 1 : 40,000, exist and are reasonably accurate, but the contour-lines are not sufficiently reliable for the purpose mentioned.

Mining operations naturally had to be commenced as quickly as possible and it was therefore decided to follow the general line of a little-used native path that passed near the vein; the best line for a wagon-road (there were several alternatives) could then be found at leisure and a permanent road constructed when the scale of operations should warrant the expenditure.

The distance from the village to the mine following the path was 9 miles. The path had to be made practicable for horses, necessitating a minimum width of 3 feet. The line was roughly surveyed and deviated to avoid the steepest grades. Four or five hundred coolies were employed to cut out the path, clear away timber, and so forth.

There was a rise and fall of 1400 ft. between the main road and the mine, gradients of 1 in 4 were frequent, three fords over knee-deep at the best had to be crossed. Mud-holes and the heaviest parts of the track were roughly corduroyed as the expense of transporting stone prohibited metalling except near the rivers.

The track attained the dignity of a bridle-path negotiable by sure-footed ponies after about two months' work at a cost of nearly £800. Riding up-hill was all right, but it was distinctly more comfortable and safer to walk down. Development of the vein by adit-levels commenced soon after work on the path was begun, sufficient tools, stores, etc., being brought over somehow. As soon as practicable transport was systemized and everything carried over on contract.

The Malays in Sumatra are generally accustomed to carry loads on their heads, the limit of weight being 40 or 50 lb. Heavier loads had to be borne between two or more coolies, slung on a pole resting on their shoulders. At first the coolies were no good at this work, but they improved with practice and after a year 8 or 10 of them could be induced to carry weights up to 500 lb. between them.

Owing to the transport difficulties I stipulated when a Pelton wheel, generator, electric hoist, pumps, etc., were ordered that weights should be cut down to 150 lb. wherever possible and that no one piece should weigh more than 500 lb. However, the first manifest staggered us, as several pieces of machinery on the way weighed about a ton and many over 1000 lb. On receipt of this information 500 coolies were put on to the bridle-path to widen it from 3 to 6 ft., straighten out the worst of the bends, strengthen bridges, etc. Efforts were made to import coolies specially trained to carry heavy weights, to get the machinery brought over on contract by Chinese contractors, and to train water buffaloes to pull sledges. These methods all failed.

The first few pieces of 800 to 1000 lb. weight were carried by 70 or 80 coolies to each piece with a European in charge. Though the coolies were offered extra pay if they got through in a certain time this method proved troublesome and expensive. The work was dangerous owing to the steepness of the mountain sides and the slippery nature of the clay soil. Coolies ran away in the jungle and disappeared. Probably most of the coolies would have ceased to work for the company had this method been continued. Finally, a sliding scale of pay was devised, based as accurately as possible on the time and number of coolies probably required to bring different weights to the mine. Naturally the price paid per 100 lb. increased rapidly for pieces over 300 lb. in weight, so that it cost about £20 to take a ton the 9 miles from the main road to the mine. The natives were promised cash payment as soon as they delivered their freight, a bait that proved particularly attractive.

As soon as this system was known among the native villages parties of 10 to 50 coolies clubbed together, they examined the cases, etc., at the depôt on the road, inquired carefully how much they would get on delivery of each case at the mine, and finally selected their load. If over 400 or 500 lb. weight, they made a rough sledge partly tied together with creepers, partly nailed with a few 6-inch nails we were glad to give them, tied jungle ropes to the sledge, lifted the case on to it, and with some pulling, some pushing, and all shouting, started off. Some heavy pieces took 12 to 15 days on the way, but all eventually arrived at the mine, the last stretch being accomplished with great enthusiasm. The number of coolies engaged was divided into the amount owing and each coolie was given his share in 'spot cash.'

By this means practically no European supervision was required. The natives liked the work, as they were not worried by Europeans or native foremen at all; they could knock off when they liked and felt jolly independent, quite an important point when free labourers have to be encouraged to work. At the same time the harder they worked and the quicker they delivered the goods the better pay they got per day.

Nothing was broken in transit, a creditable performance on the part of the natives, as there was always a risk of a sledge taking charge and sliding over one of the numerous steep banks at the side of the track. Certain articles expressly packed in tin-lined cases arrived soaking wet, as no further precautions had been taken until it was found that the Customs office at the coast invariably cut the tin lining to check the contents for revenue purposes. After this unwelcome discovery, all articles liable to damage from water were roofed with a piece of corrugated iron to keep out the tropical rain.

Malays working as carriers at the Kinandam mine, Sumatra.

ALLUVIAL MINING IN THE URALS.

Winter methods of winning platinum and gold. Open-cut work in summer. Tribute-work. Prospecting.

By JOHN POWER HUTCHINS.

Introductory.—Probably more than 90% of all the gold that has been mined in Russia and Siberia has come from placers, and even now the proportion of gold from auriferous quartz veins, with that produced as a by-product with copper, is a small one. While there will be an increase in the amount of gold won from veins, it is not likely that it will at any early date equal in amount that recovered from placers, which outnumber the auriferous quartz mines and are found distributed over a larger territory.

The following descriptions of alluvial mining are given to illustrate typical operations. These, being quite different in many respects from mining methods in other parts of the world, are interesting. They possess also a certain instructive value in demonstrating how *not* to do things.

Gold was discovered in the Urals about 200 years ago, and mining has been continued since that time. Some rich placers were worked, but, at the present time, most of them have been exhausted. However, an unimportant amount of small-scale mining is carried on by peasants working placers on their own lands or else as tributers. Much of this small-scale mining is done in winter when the peasants have little else to do; and as their time is cheap, they work very low-grade ground with the help of wife and children. Winter wages for common labour are only 25 to 35 cents and $17\frac{1}{2}$ to 20 c. per day for men and women respectively.

Platinum was discovered in the middle of the last century. The low price for that metal until recently—ten years ago it was less than one-half the present price—was not a stimulating factor. Now, however, with a price about twice that of gold, mining for platinum has assumed a greater importance in the Urals than mining for gold. The methods of mining, however, are much the same for both metals.

Winter Drift-Mining.—The following is a typical example: The deposit was loose and unfrozen, and on a low bench or terrace paralleling a small stream. The workings were dry. The depth from surface to bedrock was about 14 ft., and the thickness of the platiniferous material from $3\frac{1}{2}$ to 7 ft., including about 7 inches of decomposed bedrock, which was also extracted. The average thickness of profitable material was about $4\frac{1}{2}$ feet.

The prospecting was done in summer. Untimbered circular pits of $3\frac{1}{2}$ ft. diameter cost 25 c. for the first 7 ft., each additional 7 ft. costing 10 c. more than the previous 7 ft. Timbered pits, $3\frac{1}{2}$ ft. sq. outside the timbers, cost 40 c. for the first 7 ft., each additional 7 ft. costing 10 c. more than the previous 7 ft. Timber was delivered free to the contractors by the owners, but was framed by the former. Water, if encountered, which was sometimes the case in summer, was pumped by men furnished by the owner.

Mining was done preferably in winter, because of the easier and cheaper transport to the washing-plant, on sleighs in winter as against wagons in summer, and because in winter the workings were dry, all surface water being frozen. The placer was not rich or large enough to have warranted a complete, and, therefore, cheap system of transport to take gravel to the washing plant or for conducting water to the placer and having a washing-plant there. Mining and washing were done during the day-time only.

The method of mining is illustrated in plan in Fig. 1.

The inclines cost 6 to 12 c. per cubic yard of excavation, depending upon the distance the excavated material must be hauled to the waste-pile. The interval between inclines is made such that the maximum distance for wheeling gravel from the face to the incline shall not be more than 175 ft. From one incline 8 to 10 faces are worked at a time, giving an output of about 50 to 60 cu. yd. per working-day of 12 hours.

Shafts instead of inclines are used when the depth to bedrock exceeds 24 to 27 ft. The interval between shafts is the same as between inclines. Hoisting is done by horse-whims working two buckets, one at each end of the rope. The normal output per shaft per day of 12 hours was about 50 cu. yd. The size of shafts is 56 by 84 in. inside timbers. The cost of shaft-sinking is \$2·50 for the first 7 ft. and 50 c. more for each subsequent 7 ft. Timbers are delivered free at the collar of the shaft by the owner, but the contractors frame them.

The crew consists of:

Underground,	2 men each working	6 hours	at 30 c. =	60
Surface	3 ,, ,, ,,	12 ,,	,, 60 c. =	90
Man & horse	2 each working	6 ,,	,, 65 c. =	130
				\$2·80

This is about 6 c. more per cubic yard than with inclines.

When drifting, each section of ground is opened by a cross-cut, then work proceeds as shown by the figures. As gravel near the incline and cross-cut is apt to freeze, it is mined first at points so numbered. All drifts or breasts are 7 ft. wide outside the timbers. The thickness of gravel mined depends upon the depth of the 'pay,' but is never less than $3\frac{1}{2}$ ft., as then it would be too difficult to use the wheelbarrows. Miners are paid per shift. One miner and one wheelbarrow-man have to excavate and tram to the incline about 3·2 cu. yd. and to timber the excavation, that is, a breast 7 ft. high must be advanced 21 inches and timbered, or a breast 42 in. high must be advanced 42 in. and timbered, and so forth. Usually this work takes less than 6 hours; ordinarily the working day is divided into 2 shifts of 12 hours each.

Timbering.—One hundred round timbers 5 to 10 in. diam. cost about \$1·10 delivered at the inclines. The length varies from $3\frac{1}{2}$ to 7 ft., and averages 63 in. The cost is independent of the length. For splitting and framing the timbers, one cent per set of 3 timbers is paid. These sets are put in place by the miners. Reinforcing timbers are prepared afterward and set up by special timbermen, who receive 35 c. per 7 linear feet of reinforcing timbers, including 12 posts. The accompanying Fig. 3 shows the method employed.

Timber for planks costs $12\frac{1}{2}$ c. per piece 21 ft. long and 10 to 16 in. diam. Whip-sawing costs $6\frac{1}{2}$ c. per cut 21 ft. long. Planks are laid where the floor is wet, at a cost of 35 c. per 21 ft. of breast, covering the full width.

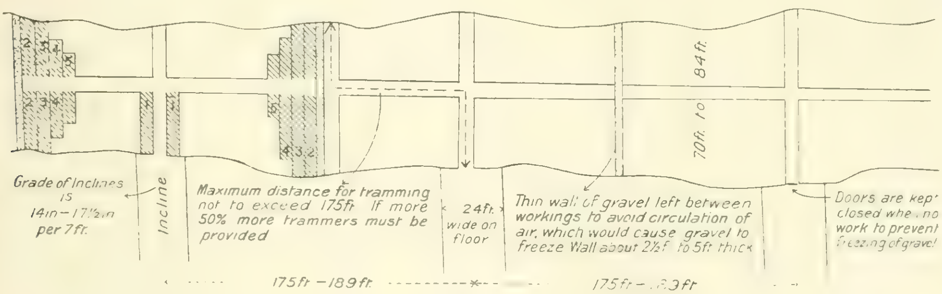


Fig. 1.

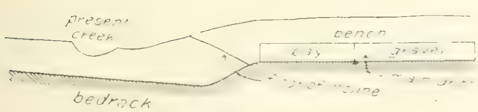


Fig. 2.

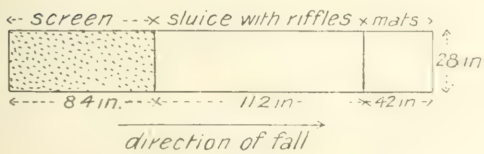


Fig. 4

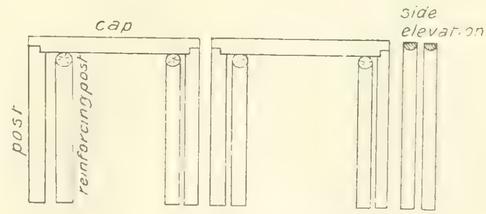


Fig. 3.

Transport of gravel is effected on sleighs, which are loaded at the inclines by hand-shovelling, proceeding thence to two washing plants respectively $1\frac{1}{2}$ and $\frac{1}{2}$ miles. Hauling is paid per load.

Washing is done in one shift of 12 hours, including 1 hour for dinner. No. 1 washing-plant has one *butara*, size as shown in Fig. 4. A *butara* more nearly resembles a rocker or long tom than any other placer device. It is motionless.

The crew for the washing-plant includes: 1 foreman outside building, 1 foreman inside, 6 girls (each paid 25 c. per day), 1 clean-up man, 1 man shovelling oversize tailing out of building, 4 men shovelling undersize tailing from tailing-ditch outside building. The crew for disposing of tailing includes: 1 man and horse hauling oversize tailing, 3 men and two horses hauling undersize tailing.

The washing-plant, as shown in the accompanying sketch Fig. 4, operates with extreme temperatures of *minus* 40° F.

The small washing-plant has one butara 7 ft. long and 28 in. wide; it has no mats and uses no quicksilver. The crew for the small washing-plant is as follows: 1 foreman, 2 men washing, 1 clean-up man, 1 man shovelling out oversize tailing, 1 man shovelling out undersize tailing. One man and one horse haul away both over and undersize tailing.

The working cost and efficiency are shown by the following tables, based upon the working 2572·5 cu. yd. gravel (202·5 cubic sagenes).

MINING:

	Total. $		Per cu. yd.
Labour:			
Miners	283·50		
Trammers	250·40		
Timbermen	74·59		
Blacksmiths	27·59		
Miscellaneous horse hire	52·00		
		688·08	26·3 c.
Timber:			
6125 mine timbers at 1·095 c.	67·36		
75 large timbers for plants at 12·5 c.	9·37		
85 long poles at 5 c.	4·25		
Whip-sawing 232 cuts 21 ft. long for planks, per cut 6·5 c.	15·08		
		96·06	3·7 c.
Stores:			
17 wheelbarrows at 10 c.	1·70		
31 wheels at 7·5 c.	2·37		
288 lb. candles at 0·12 c.	34·80		
Miscellaneous stores	40·00		
		78·87	3·0 c.
Foremen:			
1 Foreman at $12·50 per month		25·00	1·0 c.
		888·01	34·0 c.
Transport:			
Hauling 158·8 cu. sag. or 2016·76 cu. yd. 9166 sleigh-loads of 0·22 cu. yd. per load at 7·8 c. per load for 1·6 miles	719·34		
Hauling 43·7 cu. sag. or 554·99 cu. yd. 2522 sleigh-loads at 3 c. per load for 0·5 miles	75·66		
		795·00	30·9 c.
Washing:			
No. 1 Washing-plant:			
Foremen	36·00		
Labourers	160·97		
No. 2 Washing-plant:			
Foreman	21·00		
Labourers	67·19		
		285·16	11·1 c.
Tailing Disposal:			
No. 1 Washing-plant	86·50		
No. 2 Washing-plant	29·75		
		116·25	4·5 c.
General Expenses:			
3 Inclines	113·48		
Transport, food, and stores	33·80		
Watchmen	8·00		
Firewood 17·1 cu. sag. at R4·28 per wood sagene of 114·3 cu. ft. or $2·74 per cord of 128 cu. ft.	36·63		
One bunk-house	17·50		
Miscellaneous stores	3·80		
Erection of No. 2 washing-plant	10·35		
Bonus to overseer and foremen	36·23		
		259·79	10·1 c.
Total cost		$2344·21	90·6 c.

Economic Results.—Fifteen funts and $9\frac{1}{4}$ zolotniks, or 198 ounces were recovered at a cost of R3·33 per zolotnik or about $12·50 per oz. The selling price was about R10 per zolotnik or about $38 per oz. One cubic sagene of gravel averaged 7·15 zolotniks of platinum, equalling a content of 45·7 dolis per 100 poods. Reducing to cents per yard, the pay-gravel contained $2·62 worth of platinum per cubic yard. One cubic sagene was found to weigh 1500 poods, as was determined by actual weighing of the gravel. Usually 1000 to 1200 poods of 36 English pounds are estimated to be the weight of one cubic sagene of gravel. One cubic sagene equals 12·7037 cubic yards.

Results are outlined in Tables I to VI. One day equals 12 hours; volumes are measured in situ; foremen are not included.

In 45 working days of 12 hours, 2572·5 cu. yd. were worked or 57·1 cu. yd. per day.

Timber consumption per 10 cu. yd. of gravel was 23·8 timbers 63 inches long equal to 124·9 running ft., 0·29 large timbers for planks 21 ft. long equal to 6·0 running ft., 0·32 long poles 21 ft. long equal to 6·72 running feet.

There were transported 11,688 sleigh-loads equal to 202·5 cu. sag. or 2572·5 cu. yd.; therefore, one sleigh-load was 5·94 cu. ft., and weighed 936 lb., allowing 1 cubic sagene to weigh 1500 poods, or 1 cubic yard to weigh 4300 lb. This may seem excessive, but, as noted above, it was determined by weighing measured amounts of gravel.

Table I.

Labour	Average number of men per day		Average wage per day in cents		Labour units per 10 cu. yd. and day		Labour cost per cu. yd. in cents.
	Men	Man and horse	Men	Man and horse	Men	Man and horse	
Miners 2 shifts of 6 hours	18·0		35·0		3·15		
Trammers ,, ,, ...	18·7		29·6		3·27		
Timbermen 1 shift of 12 hours	4·3		38·3		0·75		
Blacksmith ,, ,, ...	1·7		35·1		0·29		
Miscellaneous horse labour ,,		1·8		65·0		0·32	
	42·7	1·8			7·46	0·32	26·7

Table II.

Washing-plant	Distance in miles	Days	Sleigh-loads per day	Cubic yards per day	Horses per day	Sleigh-loads per horse and day	Cu. yd. per horse and day	Average wage per day Cents	Labour units horses per cu. yd. and day	Labour cost per cu. yd. in cents
No. 1......	1·6	45	203·7	44·8	25·5	7·99	1·75	62·5	5·68	35·6
No. 2......	0·5	39	64·7	14·2	2·9	22·3	4·90	67·0	2·03	13·6

Table III.

Washing-plant	Days	Washed per day cu. yd.	Labourers per day	Average wage per day Cents	Labour units per 10 cu. yd. and day	Labour cost per cu. yd. Cents
No. 1............	45	42·9	12	28·7	2·79	8·0
No. 2............	39	14·2	5·4	31·8	3·79	12·1

Table IV. Tailing Disposal.

Place	Man per day	Man and Horse per day	Average wage per day		Labour units per 10 cu. yd. and day		Labour cost per cu. yd.
			Man. Cents	Man & Horse. Cents	Man	Man & Horse	Cents
No. 1	1	1	34·1	75·0	0·23	0·46	4·3
No. 2		1		75·0		0·71	5·3

Tables V. and VI. Summary of Cost and Efficiency.

No. 1 Washing-plant	Labour units per 10 cu. yd. and day		Cost per cu. yd.
	Men	Man & Horse	Cents
Mining	7·46	0·32	26·7
Transport ..		5·68	35·6
Washing ...	2·79		8·0
Tailing disposal.....	0·23	0·46	4·3
T't'l Labour	10·48	6·46	74·6

Other expenses...............19·6
Total cost per cu. yd.......94·2

No. 2 Washing-plant	Labour units per 10 cu. yd. and day		Cost per cu. yd.
	Men	Man & Horse	Cents
Mining	7·46	0·32	26·7
Transport ..		2·03	13·6
Washing ...	3·79		12·1
Tailing disposal.....		0·71	5·3
T't'l Labour	11·25	3·06	6·77

Other expenses...............26·7
Total cost per cu. yd.......79·4

Sundry features call for comment. To one familiar with drift mining in America, the most striking feature is the system of close timbering, which is not limited to heavy gravel, but is used everywhere in the Russian Empire, even where ground is solidly frozen. It is difficult for one familiar with similar mining elsewhere to account for a system that uses such a large amount of unnecessary timber, and in such an inefficient way, for it is quite impossible in heavy or 'running' ground. A which is not the case, because rectangular sets are unstable for anything but perfectly vertical stresses. One is even more astonished to see much the same system in vein mines where a few stulls would suffice.

From the tabulations it will be seen that the cost for timber is only 3·75 c. per cu. yd. This is mainly due to the extreme cheapness of the timber; it will be noted that the mine timbers, 5 to 10 in. diam. and averaging 63 in. long, cost $1·10 per hundred delivered at the

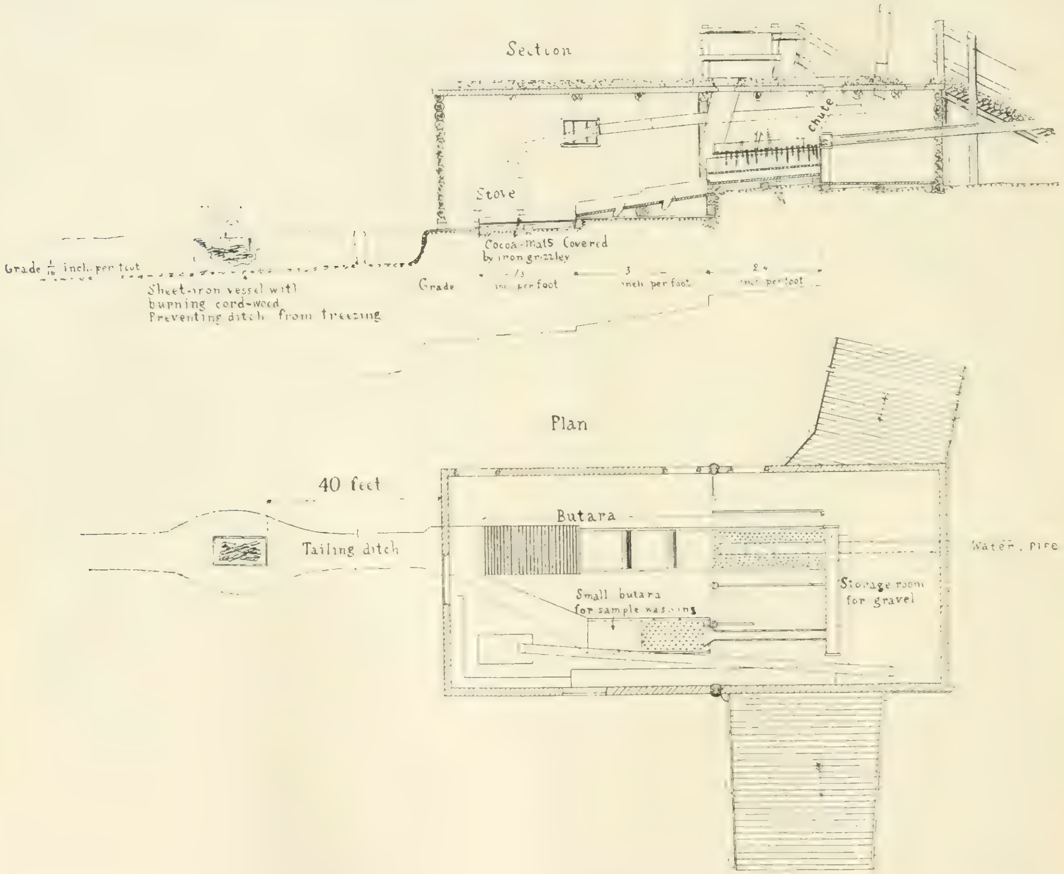


Fig. 5. URAL PLATINUM-WASHING PLANT.

few words as to the origin of the method will not be amiss.

When drift mining was begun in Russia, forests were plentiful at the mine, and so there was no need to economize in timber. Moreover, the Russian mining law is such that, in case of accident, the responsibility must be fixed upon someone, usually the mine foreman, who may have to serve a term of imprisonment. Thus the foreman, in not wishing to take any chances, keeps all excavations closely timbered, thinking that this means safety, inclines. Timbering will be further discussed when describing gravel mining in Siberia.

The cost of making open-cuts, as appears in the data concerning inclines, of 6 c. to 12 c. per cu. yd., will seem abnormally low, particularly when one remembers that all the ground is shovelled by hand. Similar excavations are made with plow and scraper in America under like conditions for about the same cost. Mechanical excavators are little used for such work in Russia. Thus on railroad construction the excavating has been done with hand-shovels. This is not hard to explain. Work done with hand-shovels and horse-carts is cheap, but as soon as mechanical appliances are introduced, the general ignorance of the unskilled labour and the remoteness from shops and foundries, resulting in delays and heavy expense for repairs, make for high cost.

obtained faster with pit-sinking than drilling, for sinking in twenty or more pits can be carried on simultaneously, and more numerous samples can be obtained in a given time than with drilling. However, when there is water to handle, or when ground is over 15 to 20 ft. deep, it is cheaper to drill.

The system of underground transport will

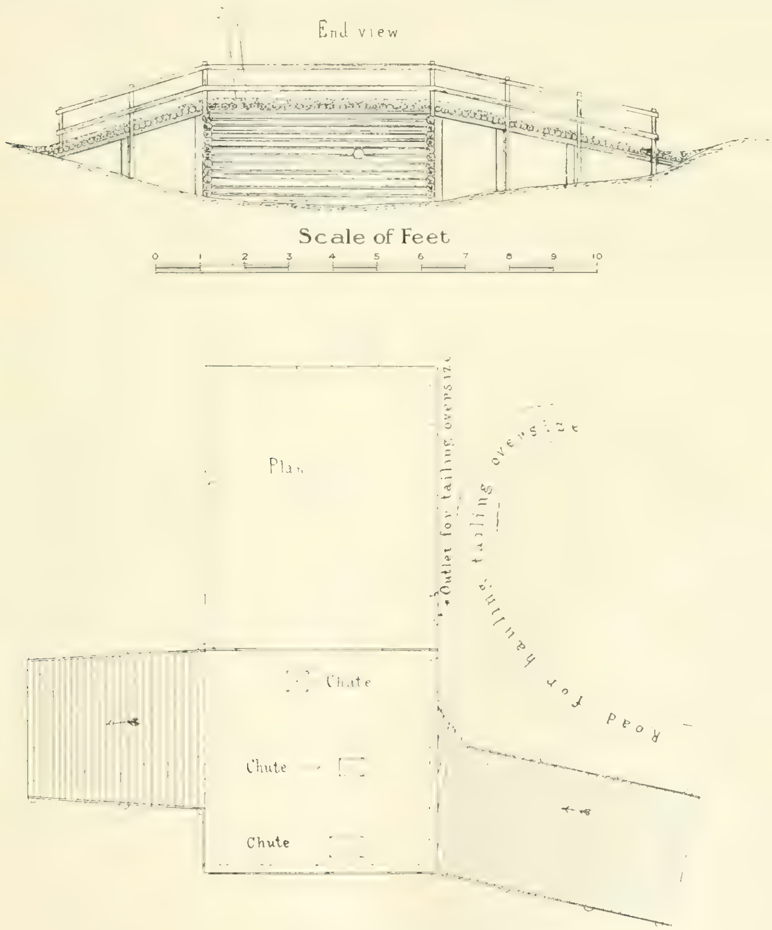


Fig 6. URAL PLATINUM-WASHING PLANT.

The cost of the circular pits, 3½ ft. diam., namely, 25 c. per first 7 ft. and 10 c. more per each additional 7 ft. is low. Thus a pit 28 ft. deep would cost only about 6 c. per ft. These figures are well worth remembering when examining placers in the Urals. For shallow and dry gravel it is slightly cheaper than drilling by hand or machine. I did hand-drilling in the same region in easy gravel about 15 to 20 ft. deep, averaging 50 to 60 ft. of drilling per 11 hours, with 5 men and 1 horse at a cost of about 8 c. per foot. Data can be

appear primitive, but it is in vogue in nearly all drift mines and in most quartz mines also, in the Russian empire. The wheel-barrows are home-made and are of poor design, putting most of the weight of the load upon the arms. The wheels are so small that it is difficult to push over obstructions, and the bearings are such as to cause excessive friction. It is remarkable to see men using wheel-barrows in breasts only 3½ ft. high. Of course, it is difficult and tiring with poor wheel-barrows, but it would not be easy even with the best kind. I have seen tramming with wheelbarrows for distances of 500 ft. from the face to the skip even in mines where the breasts were 14 ft. wide and 10½ to 14 ft. high. More will be said concerning underground transport later.

Transport on the surface is seen to cost more than mining and timbering together. This is not exceptional in the Russian empire, and even at some of the largest drift mines in the Lena and Amur river regions a similar condition may be observed. It is noteworthy that the amount hauled per load is only about 1000 lb., even though done on runners over good snow roads. This is an eloquent commentary on the small size and weakness of the Siberian horse, which is generally under-sized, under-fed, and over-worked. The average weight of the Siberian horse is under ten hundredweight.

The load of gravel is covered with a tarpaulin to prevent freezing while on the way from the inclines to the washing-plants.

Washing gravel with temperatures of 40° F. below zero is surprising to one not accustomed to Siberian work. It is accomplished in the following manner and is illustrated in Figs. 5, 6 and 7.

In spite of picturesque descriptions by romancers, describing Arctic conditions with "streams, solid, scintillating ice to their very frozen beds," there is water running under the ice of all except the smallest streams. By building a dam and tapping it from the bottom, a supply of water can be had, even in the coldest weather. This is conducted in covered or buried home-made wooden pipes to the building in which the washing is done. This building is heated, so no difficulty is experienced. A fire over the tailing-sluice, as shown, prevents freezing.

In nearly all parts of the Ural mountains and in most parts of Siberia, there is much clay in the gravel. The six girls are employed to disintegrate the clay by raking the gravel back and forth on the screen of the *butara*; water falling meanwhile from spray pipes.

The unusually steep grades of gold-saving apparatus in Siberia, as much as 4 in. per foot, or 4 ft. per 12 ft., is novel to foreign miners. There is no good reason for this, and it is poor practice.

For tailing disposal, the Russian miner has not yet come to appreciate that it is well to put the washing-plants on high ground. This is most noteworthy in the Lena region, where steam and electric transport are in vogue, and it would be quite simple to haul gravel, when once loaded into the cars, up the sides of the valley on easy grades until ample fall became available for sluice and tailing. Water can be ditched to the washing-plants. Instead of doing this, the plants are placed in the bottom of the valley, and the coarse tailing must be hauled up inclines to the dump, and often the fine tailing must be treated similarly, or otherwise elevated in some way. In the operations above cited the cost of tailing disposal was about 20% of the total working cost; in large-scale operations in Siberia the proportion is often more than this, when, by taking advantage of topographic conditions, the tailing could be discarded entirely by gravity and at an insignificant cost.

Open-cut work in Summer.—The following are descriptions and details of two typical open-cut operations in the platiniferous region near Ekaterinburg.

The pay-channel was about 280 ft. wide, with 4·6 ft. of overburden lying on 4·6 ft. of loose unfrozen gravel, which was free and lying on a decomposed bedrock. Overburden was hand-shovelled into horse-carts, and hauled about 280 ft. to the waste-dump. The gravel was hauled in cars an average distance of about 350 ft. The washing-plant had two *butaras* of the same size as shown in the previous description and illustration of drifting operations.

In June, working 27 days of 12 hours each, 237·2 cubic sagenes or 3019·6 cu. yd. of gravel was mined and washed, the detailed cost being as follows:

	$	$	Per cu. yd. pay-gravel.
Labour:			
Stripping Overburden 248·34 cu. sag. at 2 rs. (by contract) 3154·8 cu. yd. at 7·87 c.		248·28	8·2 c.
Shovellers, paid 3·5 c. per carload	337·36		
Miscellaneous labour	189·97		
Man and horse	15·00		
2 Foremen	16·00		
		558·33	18·4 c.
Timber:			
149 Timbers at 12·5 c.	18·62		
Sawing planks	38·38		
		57·00	1·8 c.
Transport:			
9639 carloads (3019·6 cu. yd.) 0·31 cu. yd. each		74·40	2·4 c.
Washing:			
Foreman	9·00		
Labour	319·09		
		328·09	10·8 c.
Tailing Disposal:			
Labour	21·97		
Men and horses	75·15		
		97·12	3·2 c.

General Expenses :	$	$	Per cu. yd. pay gravel.
Clerks	22·75		
Head Foreman	12·50		
Bonus to foremen	36·70		
Ditching	98·66		
Cleaning ditches	29·63		
Charcoal-burning	7·05		
Erecting bunkhouse	31·10		
Miscellaneous stores	41·23		
Hauling food and stores	39·60		
		319·22	10·5 c.
Totals		$1682·44	55·3 c.

There were recovered 1936 zolotniks or 265 ounces at a cost of R1·67 per zolotnik or $6·10 per oz. The platinum content was worth about $3·37 per cu. yd. of pay-gravel, or about $1·68 per cu. yd. from grass-roots to bed-rock.

Work was confined to the day shift; foremen are not included; volumes are in situ.

In 27 working days of 12 hours the gravel mined was 237·7 cu. sag. or 8·8 cu. sag. per day, equal to 3019·6 cu. yd. or 118·8 cu. yd., per day. See Tables VII to XI.

At the No. 2 the channel was about 175 ft. wide, overburden about 42 in. thick, pay-gravel loose, unfrozen, from 28 to 56 in. thick. The overburden was hauled about 210 ft.; the gravel trammed in cars to washing-plant on average of about 210 ft. The washing-plant had one butara of the same size as for the No. 1 Open-Cut.

In the month of June, 102·9 cu. sag. or 1307·2 cu. yd. were mined and washed in 27 working days of 12 hours each, the detailed cost being as follows:

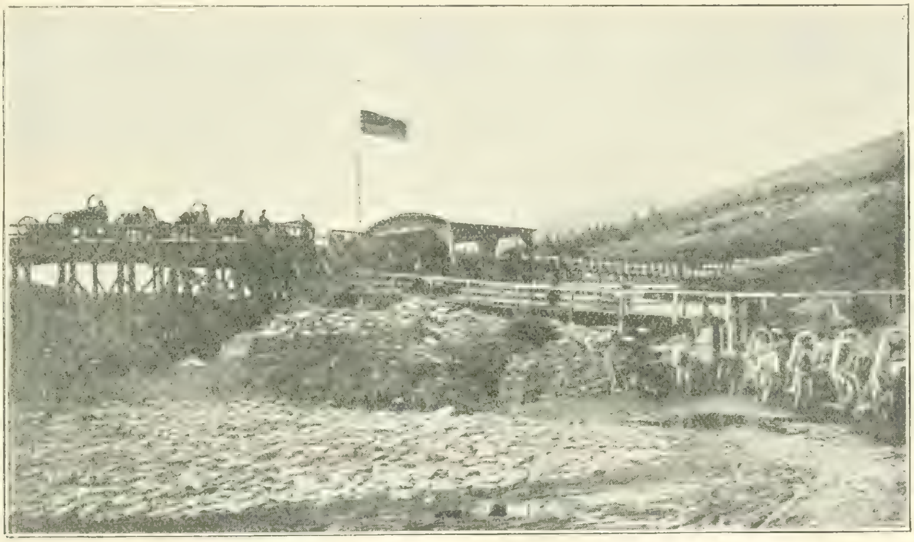


Fig. 7. A BUTARA OR GRAVEL-WASHING PLANT. The Flag indicates that operations are in progress.

MINING:

	$	$	Per cu. yd. pay-gravel.
Labour:			
Stripping Overburden 59·66 cu. sag. at 2·25 rs. 757·9 cu. yd. at 8·8 c.		67·38	5·1 c.
Shovellers' pay at 3·5 c. per carload	145·88		
Miscellaneous labour	42·26		
Man and horse	5·40		
Foreman	12·50		
		206·04	15·7 c.
Timber:			
Lumber and sawing planks		13·78	1·0 c.
Transport:			
4168 carloads=102·9 cu. sag. or 1307·2 cu. yd.		48·80	3·7 c.
Washing:			
Foreman	7·50		
Labourers	133·70		
		141·20	10·8 c.
Tailing Disposal:			
Labourers	9·96		
Man and horse (several)	37·20		
		47·16	3·6 c.
General Expenses.			
Prospecting	3·00		
Ditching	8·48		
Carting food and stores	12·00		
		23·48	1·8 c.
Totals		$547·84	41·7 c.

There were recovered 411 zolotniks of platinum at a cost of R 2·66 per zolotnik, about 56 oz., at $9·50 per oz. The platinum con-

TABLE VII.

Labour	Labour units per day		Average wage per day Cents		Labour units per 10 cu. yd. stripping per day		Labour units per 10 cu. yd. pay gravel per day		Labour cost per cu. yd. of pay-gravel
	Men	Man and horse	Man	Man and horse	Men	Man and horse	Man	Man and horse	Cents
Stripping	9·0	9·0	37·1	65·0	0·76	0·76	0·80	0·80	8·2
Shovellers	26·0		48·1				2·32		
Miscell. labour	23·5		31·3				2·10		18·2
Miscell. horse-labour		0·9		63·0				0·08	
Total labour	58·5	9·9					5·22	0·88	26·4

TABLE VIII. TRANSPORT.—One carload is equal to 0·02466 cu. sag. (8·45 cu. ft.) or 37 poods.

Distance	Carloads per day	Cu. yd. per day	Horses per day	Carloads per horse per day	Cu. yd. per day	Average wage per day Cents	Labour units per 10 cu. yd. per day	Cost per cu. yd. Cents
350 ft.	357	118·8	4	89·2	27·95	68·8	0·35	2·4

TABLE IX. WASHING.—Two butaras.

Cu. yd. washed per day	Labour units per day	Average wage per day Cents	Labour units per 10 cu. yd. per day	Cost per cu. yd. Cents
111·8	36	32·7	3·22	10·6

TABLE X. TAILING DISPOSAL.

Men per day	Man and horse per day	Average wage per day in cents		Labour units per 10 cu. yd. per day		Cost per cu. yd.
		Man	Man and horse	Man	Man and horse	Cents
2	4	41·0	69·0	0·18	0·36	3·2

TABLE XI. SUMMARY OF COST AND EFFICIENCY.

No. 1 Open-Cut	Labour units per 10 cu. yd. per day		Cost per cu. yd.
	Men	Man and horse	Cents
Mining	5·22	0·88	26·4
Transport		0·35	2·4
Washing	3·22		10·6
Tailing disposal	0·18	0·36	3·2
Total labour	8·62	1·59	42·6
Other expenses			12·7
Total cost per cu. yd.			55·3

TABLE XII. EFFICIENCY NO. 2. OPEN-CUT.

Mining: 27 working days of 12 hours; gravel mined 1307·2 cu. yd., or 48·4 cu. yd. per day.

Labour	Labour units per day		Average wage per day Cents		Labour units per 10 cu. yd. stripping per day		Labour units per 10 cu. yd. pay-gravel per day		Labour cost per cu. yd. pay-gravel
	Men	Man and horse	Man	Man and horse	Men	Man and horse	Man	Man and horse	Cents
Stripping	2·44	2·44	37·0	65·0	0·70	0·70	0·50	0·50	5·1
Shovellers	11·55		46·7				2·38		
Miscell. labour	5·46		27·3				1·13		14·8
Miscell. horse-labour		0·33		65·0				0·06	
Total labour	19·45	2·77					4·01	0·56	19·9

TABLE XIII. TRANSPORT.—One carload is equal to 00·2466 cu. sag. (8·45 cu. ft.) or 37 poods.

Distance	Carloads per day	Cu. yd. per day	Horses per day	Carloads per horse per day	Cu. yd. per horse per day	Average wage per day Cents	Labour units horses per per 10 cu. yd. per day	Cost per cu. yd. Cents
210 ft.	154·3	48·4	2·62	58·8	18·4	69·8	0·53	3·7

TABLE XIV. WASHING.—One butara.

Cu. yd washed per day	Labour units per day	Average wage per day Cents	Labour units per 10 cu. yd. per day	Cost per cu. yd. Cents
48·4	16	30·8	3·31	10·8

TABLE XV. TAILING DISPOSAL.

Men per day	Man and horse per day	Average wage per day Cents		Labour units per 10 cu. yd. per day		Cost per cu. yd. Cents
		Man	Man and horse	Man	Man and horse	
1	2	37·5	69·5	0·21	0·49	3·6

TABLE XVI. SUMMARY OF COST AND EFFICIENCY.

No. 2 Open-Cut	Labour units per 10 cu. yd. per day		Cost per cu. yd. Cents
	Men	Man and horse	
Mining	4·01	0·56	19·9
Transporting		0·53	3·7
Washing	3·31		10·5
Tailing disposal	0·21	0·42	3·6
Total labour	7·53	1·51	37·7
	Other expenses		4·3
	Total cost per cu. yd.		42·0

TABLE XVII. COST SHEET.

Items	Amount Dollars	Cost per cu. yd. Cents	Cost per zolotnik Roubles	Cost per zolotnik Cents
Foremen's wages	665·12	6·9	·28	14·0
Paid to tributers for delivered platinum......	7227·32	75·7	3·07	153·0
Totals..	7892·44	82·6	3·35	167·0

TABLE XVIII. EFFICIENCY.

Working days	Cu. yd. gravel per day	Number of butaras per day	Cu. yd. per butara per day	Average number per day of			Earned per day. Cents*			Labour units per 10 cu. yd. & day	
				Men	Women	Man or Woman & Horse	Men	Women	Man or Woman & Horse	Men & Women	Man or Woman & Horse
242	39·4	22·9	1·72	56·3	1·1	18·4	32·6	23·3	60·6	14·55	4·66

*Taking relation of man's wage at 35 c., woman's wage at 25 c., man and horse at 65 c.

TABLE XIX.

Operation	Labour units per 10 cu. yd. per day		Total cost per cu. yd. pay-gravel. Cents
	Man	Man and Horse	
Winter Drifting—			
No. 1 plant	10·48	6·46	94·2
No. 2 plant......	11·25	3·06	79·4
Summer Open-Cutting—			
No. 1	8·62	1·59	55·3
No. 2	7·53	1·51	42·0
Tribute Work..	14·55	4·66	82·6

TABLE XX.

Operation	Cu. yd. worked	Prospecting average. Dollars per cu. yd.	Ratio	Recovery average. Dollars per cu. yd.
No. 1. ...	27,728·5	1·36	1 : 2·02	2·76
No. 2. ...	24,645·7	1·24	1 : 2·61	3·24
No. 3. ...	9,382·3	1·08	1 : 2·22	2·40

tent was 3·99 zolotniks per cu. sag. or about $1·57 per cu. yd. with platinum selling at R10 per zolotnik or $38 per oz. See Tables XII to XVI.

Tribute-work.—The *staratel* corresponds to the 'layman' or 'tributer' or lessee in mining regions in other parts of the world. He is supposed to sell to the owner all he recovers at a fixed amount per unit of weight. There is the constant temptation for the tributer to steal and sell to outside buyers, who will pay more than the owners; hence constant watching is necessary. During the time of the operations reviewed in the Tables XVII and XVIII, the price paid to tributers by the owners was R 3·60 per zolotnik or about $14 per oz.; the market price for platinum was about R 10 per zolotnik or about $38 per oz. It is obvious that with such difference of price illicit traffic is difficult to prevent. The gravel was loose and unfrozen.

The gravel mined and washed amounted to 751·3 cu. sag. or 9544·2 cu. yd. The platinum delivered was 1 pood, 9 funts, 1 zolotnik, 67 doli valued at 46,056 rs.; this equals about 645 oz. valued at $23,028. Platinum content was 4·59 zolotniks per cu. sag. or $1·84 worth per cu. yd.

Comparison.—Efficiency and total cost (not only labour cost) are given in Table XIX.

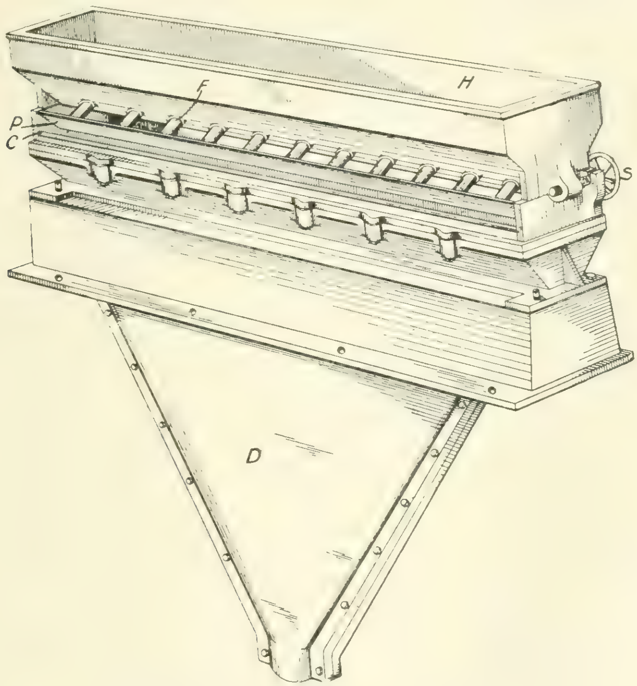
Prospecting with drills as now conducted by Russians in Siberia is done in such a way that absolutely no reliance can be placed in the results, except as a qualitative test, that is, as merely indicating the occurrence of gold. It is not necessary to chronicle the details of the prospecting procedure that are deficient, but it may be well to note that in most operations no attempt is made to encase the drill-hole when sampling pay-gravel.

Prospecting is done principally by shafts, although drills are being introduced. The results of working as compared with prospecting are as given in Table XX.

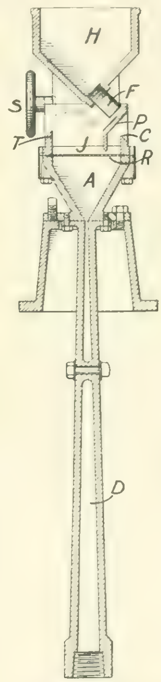
This discrepancy is difficult to explain, but there seems to be a deliberate effort to underestimate. It is customary to make a yearly prediction of the amount of gold that will be won, the cost of winning it, cost of supplies, etc. It would seem to be an example of excessive caution in which the management predicts getting less than it expects, so as to be more certain of getting the full amount forecasted.

PRÉCIS OF TECHNOLOGY

Plumb's Pneumatic Jig.—In the *Engineering and Mining Journal* for December 6, E. S. Wiard describes a new type of pneumatic jig that has been tested successfully at the Bunker Hill & Sullivan mine in Idaho. The jig has an unusually high capacity for a small screen-area, and is remarkably unsusceptible to changes in the rate and nature of the feed. Many types of pneumatic concentrators have been introduced from time to time, with indifferent results. We quote this article at length because the author is experienced in ore dressing and is familiar with the problem at the Bunker Hill & Sullivan. The machine little loss of air. The opening for the hutch-discharge is not shown in the drawing. Bolts for securing the screen-cloth (*R*) pass through it at the points shown. (*H*) is a hopper with feed pipes (*F*), which play against the baffle (*P*). By means of the handwheels (*S*), at either end, the whole hopper can be moved sideways, altering the space between the ends of the pipes (*F*), and consequently the rate at which the feed will discharge upon the baffle (*P*). The last is fixed ; the clearance between it and the screen is $\frac{3}{16}$ in. Tailing discharges the whole length of the jig at the point (*T*), and concentrate the whole length at (*C*). The mode of feeding and discharging concentrate and tailing is in marked contrast to Harz-jig practice. It would be desir-



PERSPECTIVE VIEW OF THE PLUMB JIG.



CROSS SECTION.

has the general form of the hopper of a single-compartment Harz jig, and the body is made of cast iron. It has a screen area of 3 by 24 inches. It receives its pulsations from a rotating valve connected to an air-pressure supply system, the valve being similar to those on the Richards jig and classifier. The air is introduced from below, passing up the distributor (*D*) through a narrow opening into the air-chamber (*A*) as is shown in the accompanying illustrations. The rotary valve is placed in the air-line near the jig. In capacity the jig equals or exceeds that of a Harz for a unit of screen surface. In tests, the jig attained a capacity of 6 tons per day on material that was less than 20-mesh but was greater than 40-mesh. The power required was 1·2 h.p. The screen is made of two pieces of wire cloth, the upper or protective layer being 20-mesh, while the lower, which is the screen proper, is 150-mesh. The fine that accumulates in the hutch owing to imperfect screening can be removed at any convenient point at the lower part of the jig. It has been found that with a constricted opening for the discharge of the hutch-material it will be pushed out by the air pulses with able to have a similar arrangement on Harz jigs if it were not that the escape of water on the concentrate side of the machine would be so heavy as to be prohibitive. As the concentrate-discharge lip (*C*) is a fixed integral part of the jig, the latter cannot be adjusted so as to yield concentrate of any grade desired, as on a Harz jig, by raising and lowering the concentrate gate. If the Plumb jig had an adjustable concentrate-discharge lip it would have to be raised and lowered with great caution, for the reason that owing to the greater freedom with which air passes through the interstitial passages formed by the grains composing the bed, a very slight disturbance in the balance of the concentrate and sand columns would cause all the air to pass up one column or the other. The inventor has found that a slight lowering of the concentrate column will cause all the air to pass out on the concentrate side of the machine, carrying the bed with it. An adjustable gate is almost impossible for the further reason that it could not be made to fit with sufficient perfection to prevent a serious loss of air. In order to obtain successively leaner grades of concentrate and middling, a number of the jigs would have to be run in series, the tailing of one feeding the one next below it. The concentrate discharged by the machine is always the richest material in it. On pure galena ores the concentrate contains above 80% lead. This action of discharging only the richest concentrate is not peculiar to the jig. On the Harz jig, if the adjustments are left alone, the discharges will ultimately yield only the richest material fed to any compartment, the same action as in the Plumb jig with fixed concentrate-discharge lip. The jig is not affected by changes in the rate or grade of feeding. If the grade diminishes, the concentrate stops discharging or discharges more slowly, and the reverse action ensues when the grade becomes better. The same actions take place when the rate of feed is diminished or increased. The concentrate and sand columns adjust themselves instantly to a change in feeding. The older air-jigs did not attain this perfection of balance under varying conditions because the freedom of the grains passing into them was interfered with by various mechanical devices. In the Krom air-jig, concentrate was removed below the screen by a revolving roller which could not accommodate itself to changes in the rate at which concentrate was made, and an increase in the rate or grade of feeding sent concentrate into the tailing, or the concentrate became too lean if reverse conditions ensued. The Plumb jig requires closer sizing than a Harz, and when jigging grains above 12-mesh size, the air consumption is so heavy as to be prohibitive. Pulsations vary from 400 to 800 per minute. One of the important uses to which the machine can be put is the removal, before or after tabling, of the rich grains that occur in the overlapping sand and concentrate bands from Wilfleys or tables of the kind. At the Bunker Hill mill, where the jig has been tried, results have been so striking that they may lead to important modifications in the flow-sheet. Further details of this jig, which is the invention of A. M. Plumb, of Denver, appear in *Metallurgical and Chemical Engineering* for December.

Electric Blasting.—At the October meeting of the Chemical, Metallurgical, and Mining Society of South Africa, William Cullen, T. Donaldson, and W. Waters presented a paper on electric blasting on the Rand. This method of firing is by no means new in South Africa, though it has been attracting renewed attention recently owing to its introduction at the Meyer & Charlton mine on September 29 last. In Natal the system has been compulsory in the fiery coal mines for many years, and has been used at several coal mines in the Transvaal and Orange Free State for over 10 years. Sinking has also been done by its means in some of the Rhodesian gold mines. The first experiments on the Rand were conducted at the Simmer East mine in 1904, but nothing came of them. The subject was revived by the authors in 1907, and experiments were continued at seven mines in a desultory manner for four years. It was proved that the results as regards rock-breaking were as good as with safety-fuse, but as the expense was greater the managers and contractors did not exhibit any interest. The point of view shifted a year or more ago, when underground conditions of labour began to attract attention, and the controllers became impressed with the necessity for devising means to abate the exposure of the men to dust. The first practical step was taken at the City Deep in connection with sinking operations, but the credit for introducing the system throughout a mine must be given to the Albu group for their installation at the Meyer & Charlton. The work at the latter mine was done by one of the authors of the paper.

After discussing the advantages obtained by the use of electric blasting from the point of view of the health of the miners, due to the blasting being done while they are all out of the mine, the authors proceed to give particulars of the comparative cost. The cost of material used in firing 1000 shots with the electric system was £7. 12s. 6d., and with safety fuse £5. 12s. 6d. A compensating advantage is that in each cut of 3 or 4 holes the electric system ensures the simultaneous explosion of all charges, with the result that greater efficiency in breaking the rock is obtained. Also, the drillers can fill the whole of their time below at their particular work, instead of occupying part of it in laying the fuses, for the electric connections are made by special men who come round afterward. With regard to the question of safety from accident much can be said for and against each system. In sinking, there is always danger to the workers in scrambling upward after the fuses are lit, and in any case the rush to light the fuses and withdraw to a place of safety is not unattended by risk. On the other hand a premature connection of the electric detonators would cause wholesale disaster, and special men and special precautions are necessary for their safe use. With regard to instantaneous and time detonators as applied to the electric system, it is advantageous always to use instantaneous detonators for cuts and hammer holes wherever the hanging wall is secure. For all other work delay-action fuses are recommended, and the sequence of their explosion can be arranged in the same way as with safety-fuse practice. The liability to misfires appears to be less with electric firing. At the Meyer & Charlton during the first 11 days of October, there were 35 misfires in 5903 shots, or about 3 per day. With the old system the average number was 6 or 7. At the Meyer & Charlton the 17th, 18th, 19th, and 20th levels are fitted with the electric system, and firing is in the control of the mine captain who alone has the key of the switch-box at the surface. The paper gives a full account of the installation and the method of operating it, also descriptions of the connection of the fuses with the distributing wires, and of the various types of delay-action fuses.

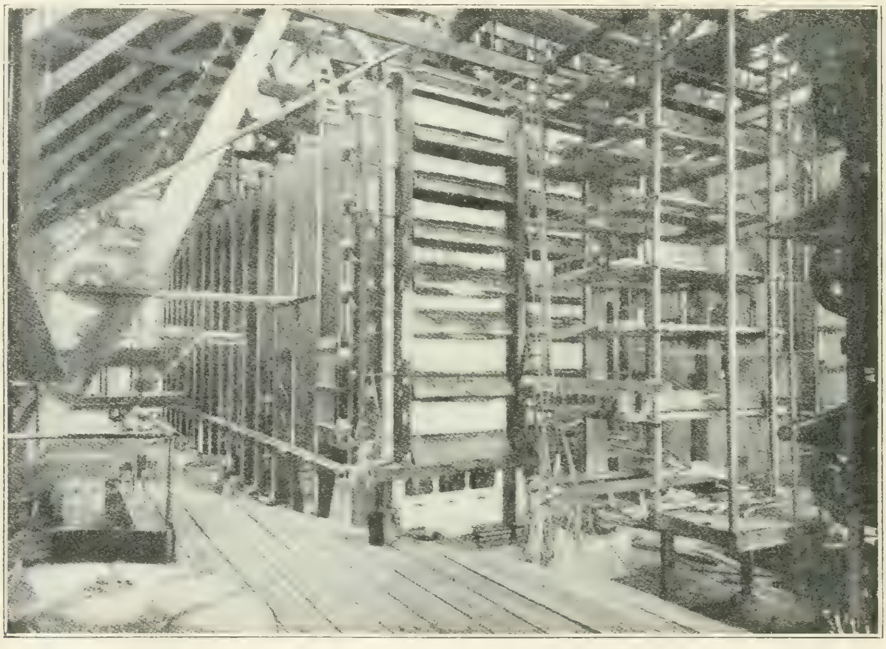
Tin in Swaziland.—A paper on the tin deposits of Swaziland was read at the October meeting of the Geological Society of South Africa, by A. L. Hall, one of the members of the Geological Survey. These deposits at Embabaan and Forbes Reef present some features differentiating them from other deposits in South Africa, more particularly the latter. The former consists of alluvial tin occurring in flats overlying a granite country, and at the latter the cassiterite is found in veins in granite and schist. The Embabaan belt is noted for the variety and abundance of accessory minerals accompanying the cassiterite: monazite, iron ores, euxenite, corundum, and tourmaline. Monazite occurs abundantly at King's Flat, but is much less common along the hill creeks; it commonly forms badly-defined clove-brown crystals, averaging about ¼ in. across, though larger irregular individuals are occasionally found up to 1½ in. in length with poorly developed facets. Among the iron ores, magnetite is common, especially at King's Flat and Stable Creek, where the cassiterite occurs in small crystals, while at Sanders Creek, where the tin ore is coarse, magnetite is scarce, so that some connection appears to exist between the fineness of the cassiterite and the abundance of iron ore, partly due no doubt to the more effective concentration along the Babaan river. The mineral usually referred to as euxenite is fairly common at King's Flat, where it occurs in small irregular blackish crystals with badly developed facets, bluish-grey on the weathered surface, but on a fresh fracture almost black, with a sub-metallic or resinous lustre. The great majority of these are about ¼ in. across, but isolated larger lumps as much as 1 in. in diameter are found. The identity of this mineral as euxenite is difficult to establish, but there is no doubt that it belongs to the aeschynite group, which comprises the four minerals aeschynite, polymignite, euxenite, and polycrase, all these four minerals being complex niobates and titanates of the cerium metals, polymignite containing a notable amount of zirconium, while euxenite and polycrase contain uranium, so that in the absence of crystals with good facets a satisfactory determination is not possible. Corundum occurs in fairly well-defined dark greyish-brown crystals up to 1½ in. in length and often exhibiting the familiar barrel shape, but larger crystals are occasionally found, as much as 3 in. across. Although no definite lodes in situ are seen, there can be no reasonable doubt regarding the source of the cassiterite. The intimate association with granite and the occasional occurrence of cassiterite-bearing quartz point to the conclusion that the ore is derived from pegmatites belonging to the older granite formation.

Forbes Reef is fourteen miles north of Embabaan, close to the western boundary of Swaziland, which here roughly coincides with the crest line of the Ingwenza range, a long and conspicuous mountain ridge made up of quartzites and schists of igneous origin belonging to the Swaziland system. Along the crest line of this chain two thick quartzites are clearly recognizable with a dip toward the east of about 69°. The eastern slopes and the low-lying ground to the east are made up of a great thickness of soft talcose, chloritic, and calcareous schist, conformable with the underlying quartzites. These schists are succeeded by granite, which is continuous all the way from Embabaan to Forbes Reef. It is practically certain that at the latter locality the granite is intrusive in the schists, while there is little doubt that the tin is derived from the granitic magma. Within the belt of schists, which begins immediately west of the old Main Reef workings at Forbes Reef, cassiterite has been found in two forms, both as lode tin. In the one case the ore is found in a vein of igneous origin, in the other the cassiterite crystals are embedded in the schists themselves.

The granite occurrence will be considered first. Within the schist zone and about one mile from the contact with the granite, a lode has been followed for a distance of about 100 yards, cutting obliquely across the strike of the schists. It is from 2 to 3 ft. wide, and at the surface badly defined against the country rock, though in samples from the deeper workings a fresh contact can be observed. The lode itself consists almost entirely of fresh, white felspar with small irregular patches of dark greenish-grey chlorite, and contains crystals of brownish-black slightly resinous cassiterite in isolated scattered blobs up to the size of a florin, or in elongated streaks. It is in sharp contact with a dark greenish chloritic layer from 2 to 6 in. wide, which shades off into the soft schist of the country. The amount of cassiterite is small near the surface, but appears to increase with depth. There is little doubt of the igneous origin of this lode and its mode of occurrence suggests a derivation from the intrusive granitic magma, possibly as a form of pegmatite, though its general characters are not quite like the usual granitic pegmatite. At various localities within the belt of schists and at the same horizon as the tin lode, tourmaline and staurolite are abundant. Isolated from the matrix, the crystals of cassiterite present distinctive characters, as they are badly defined and show highly irregular pitted surfaces, not unlike clinker. In this respect there is a striking difference as compared with the well-formed crystals of cassiterite belonging to the second mode of occurrence described in the next paragraph.

Close to the above described occurrence of lode tin, but a little farther into the belt of schists, there are several fissures running roughly parallel with the strike; along them, over a width of about 3 in., the schist matter is tin-bearing, while little or no tin is found away from the fissures. One of the latter is well seen in a long trench, which shows the country rock dipping to the west, and is traceable all along the trench. The fissure itself consists practically of the same material as the country rock, and appears merely as the well-defined outcrop of a plane of discontinuity in the body of the schists, though in places it becomes less clearly marked. In the adjoining creek, sluicing operations have been carried out down to bedrock, and the cassiterite thus obtained is clearly derived from the underlying schists by weathering and gradual concentration. Some of the fissures can be traced in the bed of the creek itself, and at several points larger crystals of cassiterite occur in situ in the schists, not obviously connected with the distribution of the fissures. No quartz gravel occurs, but the overburden rests directly on the schist. The character of the ore in the schists differs markedly from that occurring in the granitic veins, the cassiterite forming coarse crystals with good outlines, while ruby or resin tin is common. Unlike the Embabaan occurrences none of the characteristic accessory minerals are found at Forbes Reef.

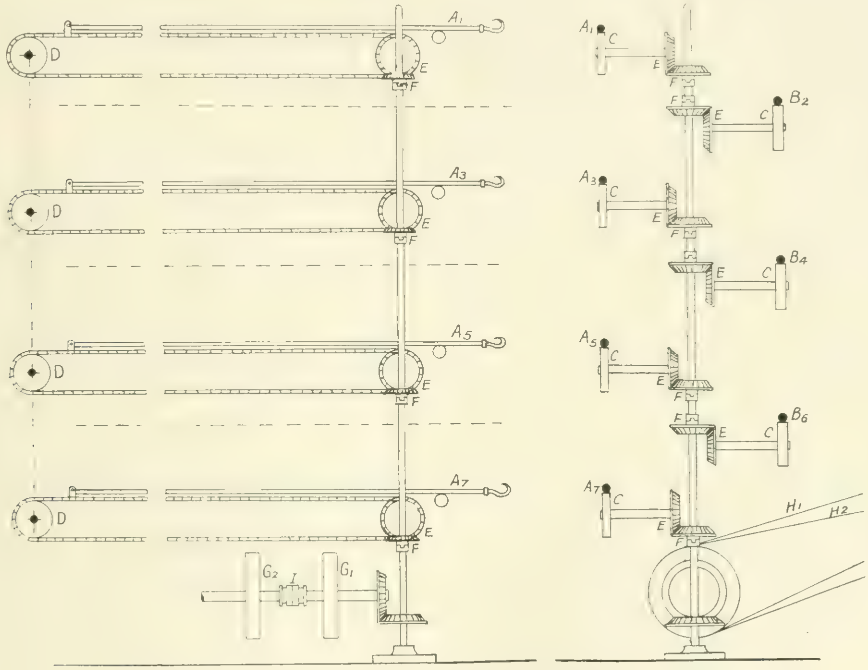
Leaching Copper Ores at Butte.—In our December issue we gave a précis of a paper describing the leaching plant at the Butte-Duluth mine, Montana. Herewith we give an extract from an article by Peter E. Peterson in the *Mining and Engineering World* for October 4, describing the plant at the Bullwhacker mine at Butte. The ore here is chiefly silicate of copper in decomposed granite. The method of treatment is to reduce the ore to pass 16-mesh, and agitate it with sulphuric acid solution in a Hendryx agitator, subsequently recovering the copper by electrolysis. The agitator contains a charge of 16 tons of crushed ore, and 32 tons of 10% solution of sulphuric acid. This charge is agitated for 2 hours during which time an almost complete solution of the copper is effected. The solution and slime is then decanted into settling tanks, while the coarser parts settle in the agitator. After the slime has settled in the tanks, the clear solution is sent to the electrolytic cells. Both the coarse pulp and the slime are washed, and afterward sluiced to the dumps. The copper in the wash-water is recovered on iron in a Hendryx revolving-barrel precipitator. In starting the process, the ore and water are first charged into the agitator and then 3½ tons of commercial sulphuric acid added. After leaching, the solution will contain about 6% sulphuric acid and from 4 to 5% copper. On the solution being sent through the electrolytic cells, about one half of the copper is precipitated, and the acid regenerated to about 9%. The solution together with part of the first wash-water is pumped to a circular wooden storage-tank, whence it is drawn as required for succeeding charges, standardized, and delivered to the agitator. The electrolytic cells are circular and made of wood, 9 ft. diam. and 5 ft. deep. They have wooden paddles for agitating the solution revolving at 8 r.p.m. The current density is 13 amperes per sq. ft. Starting sheets for the cathodes are made by depositing copper from the solution on lead cathodes. The anodes are of hard lead containing 6% antimony and weigh 10 lb. per sq. ft. The barrel precipitator for catching copper from the wash-water is 5 ft. long and 16½ in. inside diameter. It is filled with scrap iron of small dimensions. The wash-water travels quickly through it, and the precipitation is efficient. The power-cost is given at ¾ c. per lb. of copper, and the cost of acid 5 c. per lb. There are six electrolytic vats in use at present, but the plant is to be enlarged by the addition of 18 more vats, when the output of copper will be 2 tons per 24 hours. It is stated that 90% of the copper in the ore is recovered. The article contains errors in the figures for capacity, and it is impossible to say what is the average copper content of the ore treated or the time occupied by the cycle of operations in the Hendryx agitator.



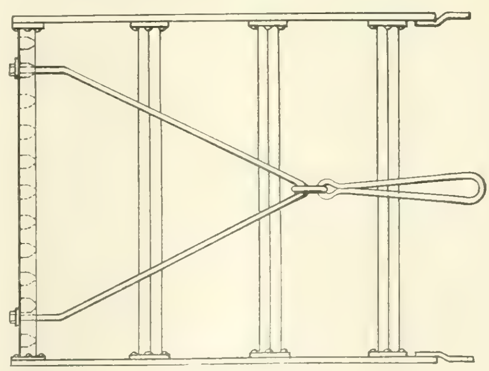
THE HEGELER ROASTING FURNACE AT PORT PIRIE.

The Hegeler Furnace at Port Pirie.—In an article by F. W. Reid appearing in the *Mining and Engineering Review* for October, describing zinc metallurgy at the Port Pirie works of the Broken Hill Proprietary, details are given of the Hegeler roasting furnace used for expelling the sulphur content of the zinc concentrate before the latter is sent to the distilling retorts. The concentrate averages 46% zinc, 8% lead, 13 oz. silver, and 30% sulphur. The sulphur must be reduced to not more than 1%. This is a difficult matter, owing to the tendency to form sulphate, which has to be decomposed at a higher temperature. It took some time to modify the standard Hegeler furnace so as to adapt it to the conditions ruling with Broken Hill material. The Hegeler is a multiple-hearth double furnace 79 ft. long, with two tiers of seven hearths, each 6 ft. wide, 2 ft. 3 in. high at the centre, and the arch of the roof springing 9 in. As originally designed, the lowest three hearths on each side were heated by gas-firing in flues or combustion chambers running underneath them, while on the other hearths sufficient heat was developed by the oxidation of the sulphur in the ore and the passage along them of the hot gases from the lower hearths. This method of firing, however, presents no advantages unless it is desired to utilize the sulphur dioxide of the hearth gases for the manufacture of sulphuric acid; and on the other hand there is the disadvantage that it is difficult to obtain the high finishing temperature necessary for the decomposition of the sulphate of zinc. A modification was therefore made whereby gas is introduced direct on the lowest three hearths by means of a number of branch pipes from a gas main on each side. The furnace was thus converted into a double 7-hearth reverberatory. The gas is supplied by two Duff producers, one for each side of the furnace. Prior to the introduction of direct firing on the hearths, air was supplied by means of fans, being first passed along a cold-air flue at the base of the furnace, then through two hot-air flues, side by side, and immediately under the lowest combustion chamber. Vertical pipes on the outside of the furnace conveyed air from the cold-air flue to the combustion chambers, and a similar set, leading from the hot-air flue to the various hearths, supplied air for oxidation of the sulphur. Air was also conducted to the hearths by means of channels up the middle wall. Now, however, the fans are not used, and air for combustion of gas and oxidation of sulphur is admitted direct to the hearths through openings in the outer walls and through the loosely fitting end doors.

The zinc concentrate is dried at the ground level by waste gases, then elevated and fed on the top hearth of each tier, but at opposite ends. The ore is stirred and moved along the hearths by means of heavy rakes or rabbles, operated by rods passing through the muffles. Each rod is attached, outside the furnace, to an endless chain, the links of which engage with a sprocket wheel, driven by suitable gearing. The rakes are drawn along the hearths and out through counterbalanced swing doors on to platforms, where they are allowed to cool. The platforms, of which there is one for each hearth level, are not fixed, but are carried on a framed turntable, which can be turned through an angle of 180°. By this means the rabbles which have made their exit from the hearths of one side of the double furnace can be brought into position for rabbling the other side. Seven rabbles thus serve the whole furnace, each making the circuit of two hearths. Outside the furnace, at each end, is a long high framework for supporting the rods and the gearing for operating them. The rods, which are carried on rollers, are necessarily longer than the furnace itself, and have to traverse the hearths in both directions. While a rod, with rake attached, is being drawn through a muffle by the gearing at one end, that at the other end is driving a detached rod through on the hearth below. By the time the first rod has landed its rake on the platform the second has been connected to the rabble awaiting it, the signal given to reverse the gearing, and the journey through the furnace commenced. Each rod is provided with an end hook for engaging with the rake, and also a shoe to enable it to ride over the ore bed when being passed through unattached The gearing is the same at both ends of the furnace, each set operating four rods on one side and three on the other. The vertical shaft (Fig. 1) is driven by bevel gearing from a countershaft carrying two pulleys, one driven by an open and the other by a crossed belt. Either of these may be thrown into gear by means of a friction clutch, thus providing the mechanism for reversing the rods. The vertical shaft carries mitre gearing for driving the chain sprockets, each pinion being provided with a jaw clutch, so that only one rod is operated at a time. The speed at which a detached rod is driven through the furnace is greater than that at which it is drawn back with the rake attached. This is effected by having the pulley driven by the crossed belt smaller than that driven by the open belt. In order that the same pulley may be in gear for the forward drive of every rod, the mitre wheels on the vertical shaft are above those with which they gear on one side of the furnace and below them on the other.



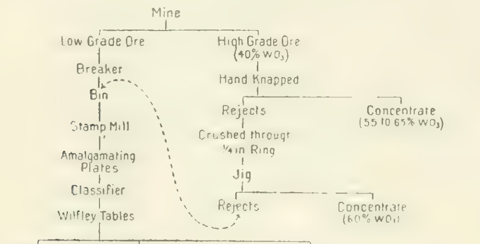
GEAR FOR OPERATING THE RAKES IN THE HEGELER FURNACE.



Details of Rakes.

The rakes are about 7 ft. in length and 5 ft. 10 in. wide, with sides of 1 in. mild steel plates 9 in. deep. There are four cross bars of cast steel, flanged at the ends for riveting to the side plates. Three of these are triangular in cross section, 3¼ in. base by 2½ in. high, and the fourth or rearmost bar is provided with teeth, which corrugate the surface of the ore after the other three bars have raked it. Attached to the sides, at the front of the rake, are small plates, termed pilots, which serve to cut the ore off the sides of the muffle. The draw-hook is of round steel, and is attached to the rear of the rake, as shown in Fig. 2. The hearth on one side are consecutively rabbled in alternate directions, from the top downwards, about a ton of charge being dropped from one hearth to the next as the rake reaches the connecting slot. The reversing table at each end is then swung round, and the other tier treated similarly. A rabbling cycle occupies about an hour. Usually a blank cycle is run on each shift, for the purpose of reducing the quantity of ore on the hearths. The capacity of the Hegeler roaster is 48 tons per 24 hours.

Scheelite-Gold Mine in New Zealand.—In the *Australian Mining Standard* for November 13, C. W. Gudgeon gives an outline of the present practice at the Golden Point mine in the Otago province of New Zealand, where scheelite, that is, tungstate of lime, and gold are obtained. The former is removed by concentration and sold to European buyers, and the latter extracted by amalgamation and cyanide.



The mine has been worked for a number of years, and the deposit has been described several times. Owing however to pyrite and arsenopyrite making an appearance at depth, modifications have been introduced in the treatment, and the flow-sheet as at September 10 last is of interest. The ore is mined in two grades, the high-grade scheelite being kept separate. The latter is hand-broken on the surface, the rejected portions subsequently crushed to ¼ in. mesh, and re-picked, the finally rejected material being sent along with the lower-grade ore to the 10-stamp mill, where it is crushed to 30-mesh. The only other mineral associated with the scheelite and pyrite in any quantity is quartz. After passing the stamp-mill, the pulp goes over amalgamating plates, where 1½ dwt. gold is extracted per ton, out of an estimated 3½ dwt. The pulp is then classified and sent to Wilfley tables. The heavy tungsten concentrate here obtained averages 30 to 40% scheelite, 50 to 55% pyrite, and 10% silica, and contains 2½ oz. gold per ton. The sandy tailing from the Wilfleys goes to cyanide vats, where 1¼ dwt. gold per ton of original ore is recovered, the final tailing assaying less than 0·2 dwt. per ton. The slime is not being treated at present, but is being impounded; its content is about 0·6 dwt. per ton of the original ore. The pyrite-scheelite content is sent to a furnace where a magnetic roast is given to the sulphide. The roasted material is passed over a Wetherill machine, where a tungsten product is obtained averaging over 60% WO_3.

Messina Concentrator.—The *South African Mining Journal* for November 1, 8, 15, and 22 gives information about the Messina copper mine in the northern Transvaal. We extract a few notes on the new concentration plant which started work last month. The capacity is from 250 to 300 tons per day. The ore as it comes from the mine is sent over picking-belts and both rich ore and waste removed. The rest of the ore is screened in trommels and the oversize crushed in Blake machines and rolls. The product is screened in another set of trommels, and four sizes obtained suitable for jigging in Harz and sliding jigs. The middlings from the jigs are re-ground in a Huntington mill and, with the fine ore that passes the trommels, sent to Janney classifiers. The spigot discharges from the latter are sent to Wilfleys, and the overflow after dewatering in Callow tanks to Frue vanners. The article does not give the mesh of the various products.

CURRENT LITERATURE.

Concrete Shafts.—At the August meeting of the Lake Superior Mining Institute, S. W. Tarr read a paper describing the replacement of timber by concrete at the Chapin mine, at Iron Mountain, Michigan.

Siberian Dredging.—In the *Mining and Scientific Press* for November 22, J. P. Hutchins describes the practice of dredging by hand current in several parts of Siberia.

Alaska Mining.—In the *Mining and Scientific Press* for December 6, F. W. Bradley describes the large low-grade gold deposit that is being developed by the Alaska-Juneau company.

Minerals Separation Process.—No. 10 of the *Proceedings* of the Australasian Institute of Mining Engineers contains James Hebbard's paper on the 'Evolution of the Minerals Separation process at the Central mine, Broken Hill,' read some months ago.

Lake Superior Copper Ores. — At the August meeting of the Lake Superior Mining Institute, R. B. Seeber read a paper describing the new crushing plant erected at the Winona copper mine. The copper occurs in the native state in the typical way in this region, and the ore is of lower grade than the average. The new plant was designed for closer concentration.

Leaching Copper Ores.—In the *Engineering and Mining Journal* for December 13, F. S. Schimerka describes experiments on low-grade ore and tailing at the Shannon mine, Arizona. The difficulty here is that the ore is basic, so that sulphuric acid cannot be economically used. It was found that sulphurous acid from the roaster gases could be applied. The ore is piled upon burning pyrite and a solution of ferrous sulphate is sprinkled on the heaps. By this means the oxide and carbonate in the ore is converted into sulphate.

Lead Smelting in America.—In the *Mining and Engineering World* for December 13, H. B. Pulsifer describes the lead-smelting plant at Herculaneum, Missouri, belonging to the St. Joseph Lead Co.

Butter's Filter-Leaf. — The *Mining and Scientific Press* for December 13 describes the new filter-leaf used in Butter's cyanide plant, devised with the object of readily dislodging the cakes.

Air-Lift.—The *Mining and Scientific Press* for November 29 contains a description of an air-lift used in the cyanide plant at the Colburn-Ajax mine.

Cupellation. — At the December meeting of the Institution of Mining and Metallurgy, C. O. Bannister and G. Patchin presented a paper giving a method for the detection of platinum metals in cupellation beads.

Cobalt Metal and Alloys.—The *Canadian Mining Journal* for December 15 commences the publication of a report on the metal cobalt and its alloys, giving the results of research undertaken for the Canadian Department of Mines.

Vanadium in New Mexico.—In the *Engineering and Mining Journal* for December 13, P. A. Larsh describes the Lucky Bill mine in New Mexico where lead carbonate and lead vanadate are mined. The ore is smelted for lead, and the vanadium-bearing slag is sold to considerable advantage.

Rand Geology.—The *South African Mining Journal* for November 29 contains a paper by J. E. Mills Davies on the geology of the Boksburg break in the outcrop of the Main Reef Series in the east Rand.

West Shining Tree.—The *Canadian Mining Journal* for November 15 reprints the official report by R. B. Stewart on the West Shining Tree gold area, in Ontario.

Queensland Gold Mining. — The *Queensland Government Mining Journal* for November contains a report by C. F. V. Jackson on the prospects of success likely to ensue from the proposed re-opening of the Palmer and other gold-mining districts in the Maytown division of North Queensland.

Mining in Algeria.—The *Mining and Scientific Press* for December 6 contains a description of the mining industry of Algeria.

Mines in Turkey.—At the December meeting of the Institution of Mining and Metallurgy, G. Maitland Edwards read a paper giving an outline of the mineral resources of the Ottoman Empire.

Deep Sinking at Charters Towers.—The *Queensland Government Mining Journal* for November contains further official records relating to the proposed deep sinking at Charters Towers, according to the scheme brought forward by Thomas Mills.

Chalcocite Enrichment. — *Economic Geology* for October prints a paper on chalcocite enrichment being part of the report by A. C. Spencer on the Ely district of Nevada, prepared for the United States Geological Survey.

Iron Ore in Chile. — The *Mining and Scientific Press* for December 6 contains an article by Carlos Vattier on the iron ore deposits of Chile.

Titaniferous Iron Ore.—Bulletin 64 of the United States Bureau of Mines written by J. T. Singewald describes the character, situation, and possibilities of the deposits of titaniferous iron ore in the Eastern States and in Minnesota, Wyoming, and Colorado; with chapters on the treatment and smelting of the ores, the microstructure of titaniferous magnetite, and the chemical composition of the ores.

Kaolin and Felspar.—Bulletin 53 of the United States Bureau of Mines written by A. S. Watts describes the kaolin and felspar industries of the Appalachian region, giving much technological information relating to the mining and handling of these minerals.

Michigan Mining.—The *Engineering and Mining Journal* for December 20 contains an article describing the contract systems in vogue in the Michigan copper mines.

Potash from Seaweed.—The *Journal* of the Franklin Institute for October contains an article by F. K. Cameron on 'Kelp and other Sources of Potash,' describing the methods of using seaweed for agricultural purposes on the coast of California.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be obtained on application to The Mining Magazine.

NEW BOOKS

Mineral Deposits. By Waldemar Lindgren. Cloth, octavo, 902 pages, illustrated. New York: McGraw-Hill Book Co. Price 25s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

The author is well known as one of the foremost authorities on economic geology; he has long been a distinguished officer of the United States Geological Survey, and he is now professor of economic geology in the Massachusetts Institute of Technology, at Boston. As a geologist, apart from keenness of observation and the ability to make logical inferences, he may be instanced as one of the first men to bring mining geology up to the modern requirements of science by making the utmost use of chemical and physical research; in other words, he proved himself well equipped for the complex problems presented to those who try to give scientific aid to the seeker for metals underground. In this book he presents a comprehensive summary of knowledge accumulated during his many years of travel and research. It is unlikely to be his last word on the subject, for he has only lately become a professional teacher of geology, but it marks his arrival at that stage when a scientific man feels that he is entitled to take stock of his intellectual gains. The book is characteristic in that it is the first effort to write a volume on ore deposits upon the basis of a consistent genetic classification. To do this requires courage and a confidence in the fixity of the theories underlying such a classification. We accept the plan of the book as indicating that one of the most authoritative writers on ore deposits believes that knowledge concerning their origin has advanced to such a point as to afford a solid basis for further study and discussion. By using the title 'Mineral Deposits,' the author widens his scope, and extends it beyond the merely economic limitations indicated by 'ore' deposits. The intimate knowledge of American mining regions that was obtained by Mr. Lindgren while on the Geological Survey has been supplemented by professional journeys to Mexico, Canada, Australia, and Europe. The geographical scope of his examples of ore deposition is wide therefore, and to it he has added a wealth of references, rendering his foot-notes an invaluable bibliography of the literature on the subject. In the early chapters he outlines the conditions governing the flow of water underground, elucidating the origin, chemical composition, and work of such mineralizing solutions. Then four chapters are devoted to the structural conditions that determine the shape and texture, the continuity and discontinuity, and the relative persistence of ore-bodies. Then comes the classification. The divisions include (*1*) Deposits formed by mechanical processes. (*2*) Those produced by chemical processes of concentration in bodies of surface water. (*3*) Those formed by evaporation. (*4*) Those resulting from rock decay. (*5*) And those concentrated by circulating waters. Next come those that originate from the activity of thermal waters and intrusive rocks, culminating in magmatic differentiation. Metamorphism and oxidation, as modifying causes, are separately discussed. Deposits formed "near the surface" are distinguished from those formed "at intermediate depth." Here we submit a demurrer: Whatever may have been the depth at which a lode or vein was first formed, it is likely that the enrichment that made it a source of wealth to man was associated with factors that came into play when, by erosion, that part of the lode or vein was brought nearer to the surface. However, on a point like this the reviewer bows to the author, who never writes or speaks carelessly. Despite debatable points, the genetic classification dominating the arrangement of the book is one that will please most readers and prove provocative of thought to all really interested in the subject. The book is written with the care of a scholar and the precision of a scientist. Having regard to the fact that English is not the native language of the author—indeed, it is a language that he learned to command at a comparatively late date—we shall be pardoned for congratulating him on his style. In this case "the style is the man." It is unpretentious, accurate, and convincing. We commend the book unreservedly as the best extant on the subject. T.A.R.

Metallurgy of the Common Metals. By Leonard S. Austin. Cloth, octavo, 530 pages, with many illustrations. San Francisco: *Mining and Scientific Press*; London: *The Mining Magazine*. Price 17s. net.

For six years Mr. Austin's book has enjoyed much vogue among learners desirous of becoming acquainted with the outlines of modern commercial processes for extracting gold, silver, copper, lead, and zinc from their ores. In many colleges it has been received with favour by the teachers. Similarly, directors, shareholders, and business men connected with mining have found that it meets their requirements, as it deals more with practice than with the theory and chemistry of the processes and reactions. The book has been revised and enlarged three times, and the new edition, the fourth, contains much new matter. The author acknowledges the efficient collaboration of M. W. von Bernewitz, formerly mill manager of the Associated Gold Mines at Kalgoorlie and now assistant editor of the *Mining and Scientific Press*, who has re-written the chapters on the cyanidation of gold and silver ores, and of R. G. Hall, for many years manager for the United Zinc & Chemical Co., who has re-written the chapter on the metallurgy of zinc.

The History of Geography. By J. Scott Keltie and O. J. R. Howarth. Cloth, small octavo, 160 pages, illustrated. London: Watts & Co. Price 1s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This book is one of the excellent series issued by the Rationalist Press Association, another of which, the 'History of Geology,' by Horace B. Woodward, we noticed recently. The authors of the 'History of Geography' are well qualified, Mr. Scott Keltie being the secretary of the Royal Geographical Society. Naturally the book does not give much information of geographical discovery and development following the search for mineral deposits, but it forms an excellent indicator for those mining engineers who may be searching for the earlier history of any particular part of the world.

Properties of Matter: Sixth Edition. By J. H. Poynting and Sir J. J. Thomson. Cloth, octavo, 236 pages, with many illustrations. London: Charles Griffin & Co. Price 10s. 6d. For sale at the Technical Bookshop of *The Mining Magazine*.

We have pleasure in taking the opportunity, on the appearance of a sixth edition, of drawing the attention of metallurgical and chemical engineers to this classical work on the physical properties of matter. The book is the first of a series of volumes entitled 'A Text-book of Physics,' written by two of our leading scientists. The applications of the book to the problems of the mining world are manifold, but we may mention in particular that the study of ore concentration requires more than a superficial knowledge of the laws of nature. The behaviour of particles of fine sand and slime on a table or in suspension depends on the principles of capillarity and surface tension, and in the consideration of the very finest slime we come to the laws of diffusion and viscosity. Some of our friends, such as Sulman, Caetani, and Simon, to mention only a few, are already close students of ore problems from the physico-chemical point of view. We expect this school to expand rapidly; therefore our recommendation of the book.

Microscopic Analysis of Metals. By Floris Osmond. Edited by J. E. Stead. Second edition, revised and corrected by L. P. Sidney. Cloth, octavo, 320 pages, illustrated. London: Charles Griffin & Co. Price 8s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Floris Osmond's classical work was translated into English in 1904, and the edition was soon exhausted. It was hoped that he would have personally prepared a new edition, but his untimely death prevented this. It was then decided to re-issue the book, adding only such matter as was in harmony with Osmond's views, and in this way to perpetuate his life's work.

The Silicates in Chemistry and Commerce. By W. and D. Asch. Translated by Alfred B. Searle. Cloth, octavo, 460 pages. London: Constable & Co. Price 21s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This book belongs to the region of profound chemistry. It consists of a study of a special branch of the theory of molecular and radicle arrangements and rearrangements, which has been developed specially by the authors to explain the behaviour of aluminium and silicon compounds. This particular theory is the 'hexite-pentite' theory, from the rings of six or five molecules in the compounds. Thus $6\ SiO_2$ is silicon hexite, and $3\ Al_2O_3$ aluminium hexite. These constructions explain a vast amount of reactions in the formation of minerals and in the manufacture of cement, glass, pottery, etc. Some day the theory will be used for explaining the behaviour of alumina in blast-furnace slags, a branch of metallurgy at present obscure.

Logging. By Ralph Clement Bryant. Cloth, octavo, 600 pages, illustrated. New York: John Wiley & Sons; London: Chapman and Hall. Price 15s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Mining engineers who have to cut, transport, and trim their own timber will find this book useful. It tells how to fell and cut the trees, haul the logs by animal power, build railways for their transport, bind them into rafts so as to float them down river to their destination. It enumerates all the commercial woods in the United States, gives rules for calculating dimensions, and includes a chapter on harvesting turpentine. The bibliography and glossary are useful adjuncts. The author is professor of lumbering in the Yale University.

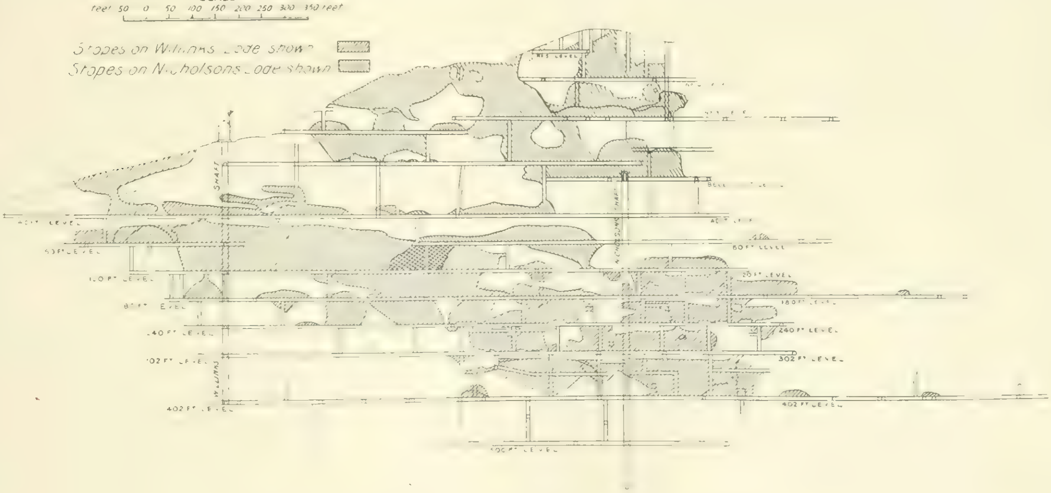
Official Year Book of the Scientific and Learned Societies of Great Britain and Ireland. Cloth, octavo, 380 pages. London: Charles Griffin & Co. Price 7s. 6d. For sale at the Technical Bookshop of *The Mining Magazine*.

We referred in this column last year to Griffin's convenient yearly index to the various technological and scientific societies of the United Kingdom, which gives details of the various organizations together with an outline of the transactions during each year.

COMPANY REPORTS

St. John del Rey.—The interim report of this company, working the Morro Velho gold mine in Brazil, for the half-year ended August 31 last, shows that 83,668 tons of ore was raised and 82,500 tons sent to the 130-stamp mill. The yield was worth £195,626, or 47s. 5d. per ton. These figures compare with 81,418 tons and 93,338 tons during the preceding half-years, during which the yield was 46s. per ton. The variation in the tonnage was due to the irregularity of labour-supply. The production was increased by £2000 from gold extracted from accumulations. The working cost at the mine was £125,354, and in London £1461 ; £7869 was spent on development, £15,000 was transferred to the fund for capital expenditure, and £9188 was paid as local taxes, etc. Debenture interest absorbed £979, and £5000 was paid as interim dividend on the 100,000 preference shares of £1 each. The ordinary shares (546,265 of £1 each) received £20,485, being 3¾% for the half-year. The labour situation is improving, as some of the large works that had provided counter-attractions have been finished. The first party of 100 Japanese labourers has arrived at the mine and the impression created by them is favourable. Development has not been as rapidly pushed as had been intended owing to this scarcity of labour. The 18th horizon was reached in May. This is 4900 ft. vertically below adit, or 5200 ft. below outcrop. On this level, driving has been done east and west 259 ft. and 222 ft. respectively, in ore of similar quality to that found on the 17th horizon, 300 ft. above. No. 23 winze is being sunk from the 17th to the 18th horizon and should make connection at any time now. After it is finished, the sinkers will start on the G shaft, which is to be deepened another 600 ft. and a cross-cut driven to the orebody. George Chalmers, the manager, gives the following figures for the proportion of ore drawn from each level during the half-year : horizon 13, 13,364 tons ; 14, 14,341 tons ; 15, 18,081 tons ; 16, 15,864 tons ; 17, 12,716 tons ; 18, 2255 tons ; winze 23, 320 tons ; and workings near surface, 6727 tons. At the metallurgical works, the percentage of recovery was 92·63.

Pahang Consolidated.—In 1887 a company called the Pahang Corporation was formed to acquire land, containing tin mines, in the state of Pahang, on the eastern side of the Malay Peninsula. For many years profits were made, and the preference shares received dividends, though the distribution on the ordinary shares was irregular. In 1906 the corporation absorbed the Pahang-Kabang and Malayan Exploration companies, and at the same time the name of the company was changed to the Pahang Consolidated, additional capital being subscribed at the time. In 1909, it was found desirable to reorganize the development on a larger scale, and by the advice of William Frecheville £125,000 additional capital was subscribed for this purpose. The results since then have been most gratifying. A profit was made for the year ended July 31, 1911, and was applied to the extinction of the adverse balance from the year before. For the year ended July 31, the working profit was £45,341, which was sufficient to provide all arrears of preference dividend. The report now issued covers the year ended July 31, 1913, and shows that the output and profit have both continued to expand, and that it has been possible to pay a dividend on the ordinary shares. It should be mentioned that the company owns a large number of lode-tin mines, and is practically the only worker of such properties in the Malay Peninsula. A section of the principal workings is given in the accompanying illustration. During the year, 127,543 tons of ore was raised, yielding 1366 tons of tin concentrate, as compared with 102,797 tons and 1125 tons tons during the previous year, and 78,448 tons and 973 tons during the year ended July 1911. In addition, the alluvial-tin ground worked by Chinese tributers, yielded 175 tons of concentrate, as compared with 115 tons and 54 tons during the two previous years. The sale of concentrate brought an income of £197,481, and the working profit, after the payment of £4035 interest on debentures, was £75,485. Out of this, £10,000 was written off for depreciation of plant, £15,689 was allowed for development of new properties, and £5000 placed to reserve. Out of the balance, £36,874 has been paid as dividend on the preference and ordinary shares, the rates being 7% and 12½% re-



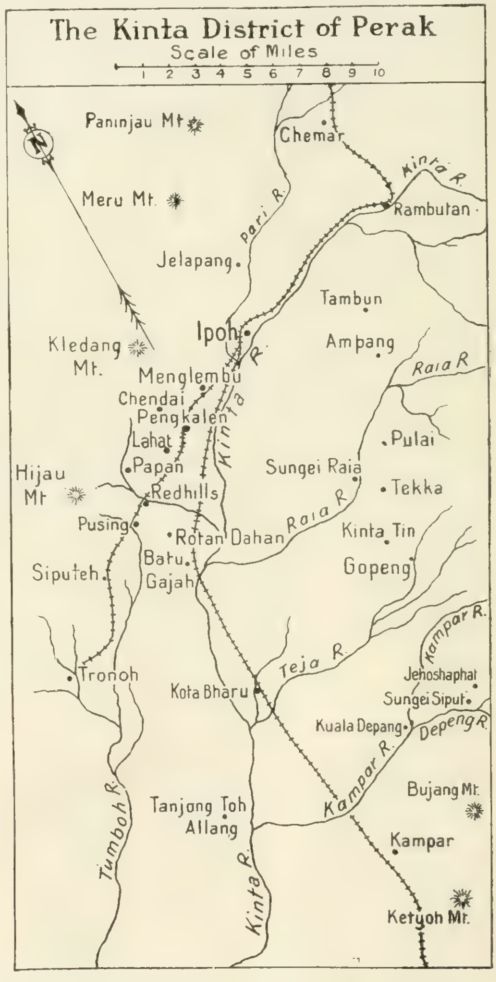
VERTICAL SECTION OF THE PAHANG COMPANY'S MINE.

spectively. During the year, 147,253 ordinary shares of 5s. each have been issued in exchange for debentures. The capital now stands at £261,907 in ordinary shares, and £54,500 in 7% preference shares. There are £3000 5% debentures outstanding and £61,000 4% debentures. J. T. Marriner, the manager, reports that the developments in depth at Willink's, the chief mine, have been extremely satisfactory. At the 500-ft. level the ore-shoot has been proved for a length of 500 ft. The width averages 15 ft., and the black tin content is from 2½ to 3½%. On the 600-ft. level, the lode has been cut, and proved for 33 ft., the average width being 25 ft. and the black tin content 5%. Nicholson's East Lode is also developing well. At the other properties, Jeram Batang, Pollock's, and Semiliang, developments have all disclosed ore at several points. At the first two, unwatering has been completed and deeper development is to be commenced. Sinking at Willink's is to be continued, and it will be necessary to provide additional pumps and other plant. It is proposed therefore to issue the balance of the preference shares, whereby £45,500 new capital will be raised. Part of this money will be applied to developing the company's rubber plantations.

Kinta Tin Mines.—This company belongs to the Luning group operating in the Kinta district of Perak, Federated Malay States. It was formed in 1900, and dividends have been paid regularly, increasing from 10% in 1902-3 to 30% in 1909-10. After the latter year, the property could not be worked effectively with the water-supply then available, and the output and dividends were reduced pending the provision of a new high-pressure supply. This supply is being developed conjointly with the Gopeng, or Wickett, companies. The report for the year ended June 30 last shows that 205 tons of black tin was won, a figure nearly identical with that for the previous year, and comparing with 322 tons two years ago. The output sold for £26,081, and the net balance of profit was £15,583. Added to the balance brought forward from last year, the total available for distribution was £19,343. Out of this, £11,250 has been paid as dividend, being at the rate of 15%. The capital of the company until a year ago was £60,000. In order to provide the share of capital required to finance the new water scheme, 60,000 new shares were then issued at 25s. each. The reserve fund now stands at £15,000. Osborne & Chappel are the managers.

Pusing Lama Tin Mines.—This company belongs to the Luning group of mines operating in the Kinta district of Perak, Federated Malay States. It was formed in 1904 to work alluvial deposits, and shortly afterward a rich vein of tin ore at the contact of the clay with a soft granite intrusion was discovered. A plant containing stamps and Wilfley tables was erected. During 1906 and 1907 satisfactory profits were made, and dividends of 37½% and 35% were paid. Afterwards the profits began to decline on the exhaustion of the lode, and three years ago the remaining parts of the property were let on tribute. The report now issued covers the year ended June 30 last. It shows that the tributers produced 126 tons of black tin, and that the company's royalty from this source was £3282. In addition £2506 was received as rent, etc. The expenses of upkeep and administration were £4090, and a profit of £746 was left. This being added to the balance brought forward from the previous year, the profit available for distribution was £2703, out of which £2500 has been paid to the shareholders as a dividend at the rate of 2½%. The board has not been satisfied with the tributing done recently, as the amount of work done has not come up to contract, and new arrangements have been made that should result in an increased output.

Redhills Tin Mining.—This company was formed in 1905 by James Wickett, of Redruth, to acquire a tin property in the Kinta district of Perak, Federated Malay States, adjoining the property of the Pusing Lama company, particulars of which are given in another paragraph on this page. A stamp-mill and dressing-plant were erected, but no profits have been made, and the property is now let on tribute. According to J. B. Scrivenor, the government geologist, it would appear that the supposed lode is really a boulder-clay characteristic of the neighbourhood, but with the tourmaline-corundum rock-boulders packed unusually close together. The report for the year ended March 31 last, now issued, shows that the tributers extracted 131 tons of black tin from the Kacha mine, and that the company's income therefrom was £3115, against which there was an expenditure of £1425. Prospecting has been continued at this property, and also at Chendai, where a true lode is giving sufficiently satisfactory results to warrant the erection of stamps and tables. The profit of the company for the year was £2094, which has been applied in reducing the previous adverse balance.



Seramban Tin Mining.—This company belongs to the Redruth group controlled by James Wickett, and was formed in 1897 to acquire alluvial tin properties near Seramban, in the state of Negri Sembilan, one of the Federated Malay States, 150 miles south of the Kinta district of Perak. The output has been on a comparatively small scale, about 100 tons black tin per year, but was sufficient to pay dividends regularly until a year or so ago on a capital of £24,000. Two years ago the output dropped to 51 tons. The report now issued, covering the year ended September 30 last, shows that 56 tons of black tin was produced, selling for £6429, which was supplemented by the sale of wolfram yielding £748. The mining cost was £5899, and home administration brought the cost to £6264. The profit was £914, which, added to the balance brought forward, made a disposable balance of £3730. No dividend is recommended. The report of the managers, Osborne & Chappel, has not yet been received.

Rambutan.—This company was formed in 1905 to acquire an alluvial tin property at the northern end of the Kinta district of Perak, Federated Malay States. It was promoted by James Wickett, of Redruth, and Osborne & Chappel are the managers. Operations have so far been conducted with a suction dredge, with indifferent results, as it was impossible to attack the lower and richer parts of the deposit or to handle a sufficiently large quantity of material. A year or more ago the managers recommended a change in methods and the adoption of hydraulicking with a high-pressure water supply. Accordingly, in October 1912, the dredge was beached, and work was concentrated on the laying of a pipe-line 5 miles long to draw water from the upper reaches of the Kinta river. The new installation is approaching completion. The report for the year ended June 30 last shows that during the four months the dredge was at work, 37½ tons of black tin was won from 89,900 cu. yd. of material. This sold for £4716. The expenses amounted to £7961.

Kledang Tin Mining.—This company was formed in 1906 by James Wickett, of Redruth, to acquire a lode-tin mine on Kledang hill, in the Kinta district of Perak, Federated Malay States. It was reconstructed in 1910. The share capital is £50,000 and £14,140 debentures have been issued. The mine is let on tribute. The report for the year ended February 28 last shows that the production was 79 tons of black tin and that the royalty derived therefrom was £1455. The expenditure at the mine and in England amounted to £755, and debenture interest absorbed £1060. The loss for the year was £362. Since the date when the accounts were closed, the yield obtained by the tributers has increased, and the board has been thus enabled to liquidate practically all the debts of the company.

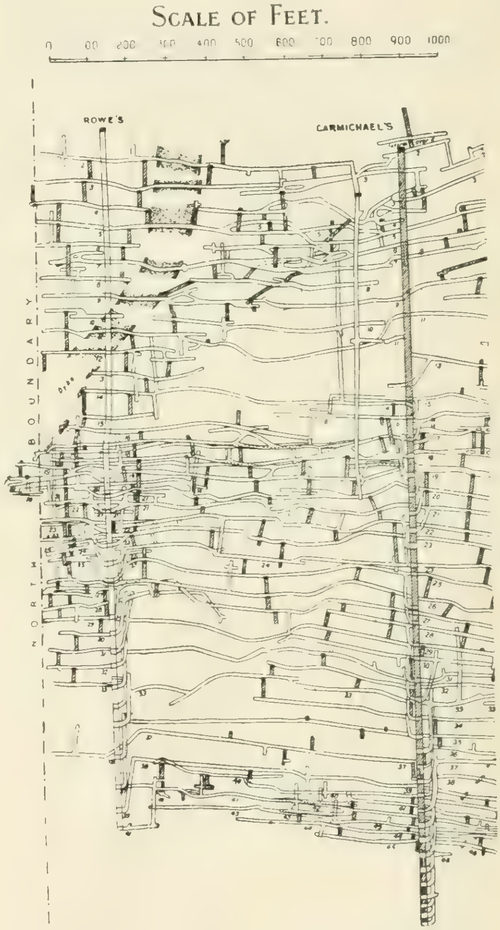
Eileen Alannah.—This company is a subsidiary of Willoughby's Consolidated, and was formed at the end of 1911 to develop the Eileen Alannah and Arizona gold-mining properties, in the Gatooma district of Rhodesia, not far from the Cam and Motor. Reports were made by A. H. Ackermann and Leopold Weill. At the time of flotation a 10-stamp mill was running, but this was put out of work and energies centred on a large scheme of development. In the meantime investigations were made as to the best method of treating the ore, which contains arsenic and antimony. F. A. Marriott, of West Australia, has devised a scheme and drawn specifications for a plant to handle 5000 tons per month. The cost of the plant will exceed the original estimates by £25,000, and this amount will have to be provided. Unfortunately, times are too unpropitious for raising further capital, so the old plant is to be requisitioned once more in order to earn the money required. It should re-commence working about the end of this year, and it should provide the required funds in six or seven months. The report now issued by the company nominally covers the year ended December 1912, but the information is brought down to the date of the signature of the report, November 17. The ore reserve is estimated at 250,726 tons with an average assay-value of just over 50s. per ton. Partly-developed ore is estimated at 50,000 tons. The issued capital of the company is £410,000.

Geevor Tin Mines.—This company was formed by Oliver Wethered in 1906, under the name of the North Levant and Geevor, to acquire from the West Australian Gold Fields the Wheal Geevor, situated near the Botallack and Levant mines at St. Just, West Cornwall. Additional capital was raised in 1909 and a further amount on the reconstruction of the company at the beginning of 1911. The capital is now £60,000 in 120,000 shares of 10s. each. A year ago £16,110 debentures were issued. Milling on a small scale has been going on since the start, but was suspended a year or so ago, during the enlargement of the capacity to 100 tons per day and the provision of modern classifying and dressing plant. Particulars of that plant were given in Horace B. Nichols' paper, an abstract of which was published in our last issue. The delay, unavoidable in the adjustment of plant working on a new system, was particularly unfortunate in the present case, where the finances of the company were causing anxiety to the board. The directors decided in April last to suspend the experimental plant and revert to standard Cornish practice. The report for the 15 months ended September 30 last shows that milling was recommenced at the end of April. During the period under review 24,546 tons of ore was treated, yielding an unspecified amount of concentrate selling for £32,077. The balance of profit was £561. In order to tide over the period of non-production, it was necessary to raise temporary loans from directors and shareholders; the amount with interest thus owing is £6605. The company has an ore reserve of £78,000 tons, sufficient to keep the mill occupied for 2 years, and further developments are encouraging. During the past summer operations were hampered by shortness of water consequent on the drought. R. Gilman Brown has resigned his seat on the board.

Cape Copper.—This company was formed in 1863 to work the Ookiep copper mine, situated in Namaqualand, on the west side of the Cape province, South Africa. Some high-grade ore is shipped, together with matte produced from the lower-grade ore, to the company's smelting works at Britonferry, near Swansea, South Wales. For some years the supply of ore has been decreasing, and other properties have been sought. The most important mine tested is in India, and it has been bought as recorded later in this paragraph. The report for the year ended April 30 shows that 12,736 tons of ore, averaging 13·3% copper, was raised from the Ookiep mine, as compared with 16,986 tons, averaging 12·4%, the year before; the reserve at this mine is estimated at 6000 tons. At the Nababeep South, 53,069 tons, averaging 4·85% copper, was raised, as compared with 55,970 tons, averaging 5·27%, the year before; developments have been good during the year, and the prospects are promising; the reserve is 150,000 tons, averaging 5% copper, as compared with 130,000 tons of the same quality a year ago. From the Nababeep North, 3755 tons of ore was raised, averaging 5% copper, and from the Narrap, 3213 tons averaging 5·6% copper. In July 1912, the smelting works at Ookiep was closed, and since that time smelting has been done at Nababeep only. A new blast-furnace has been erected, and was started in May of this year. A second furnace has recently been shipped. These two new furnaces and the reconstructed furnace will be able to treat the ores from Nababeep, and also much of the capping at that mine not included in the ore reserve quoted above. The accounts show a profit of £83,500, out of which £69,000 has been paid as dividend, being at the rate of 4s. per £2 share. During the year the contract with the Tilt Cove Copper Co., of Newfoundland, has been terminated. Prospecting work is being done at the Terra Nova mine in Newfoundland, and at a mine in Asia Minor. The report contains information about the copper mine, called Rakha Hills, in the state of Chota Nagpur, India. The option on this mine was exercised in March, and the purchase price has been paid. Charles Olden has been in charge of the development work. He reports the proved ore to be 239,205 tons, averaging from 2½% to over 5% copper. The prospects at this mine are so satisfactory that the directors have decided to issue 200,000 new shares at £1 each in order to provide the capital necessary to equip the mine and continue development. It should also be mentioned that the Britonferry works have been practically rebuilt during the past two years, and have been thereby brought thoroughly up to date. The works will now be able to handle increased amounts of custom ore, and part of the new capital will be applied in financing the purchase of such ore.

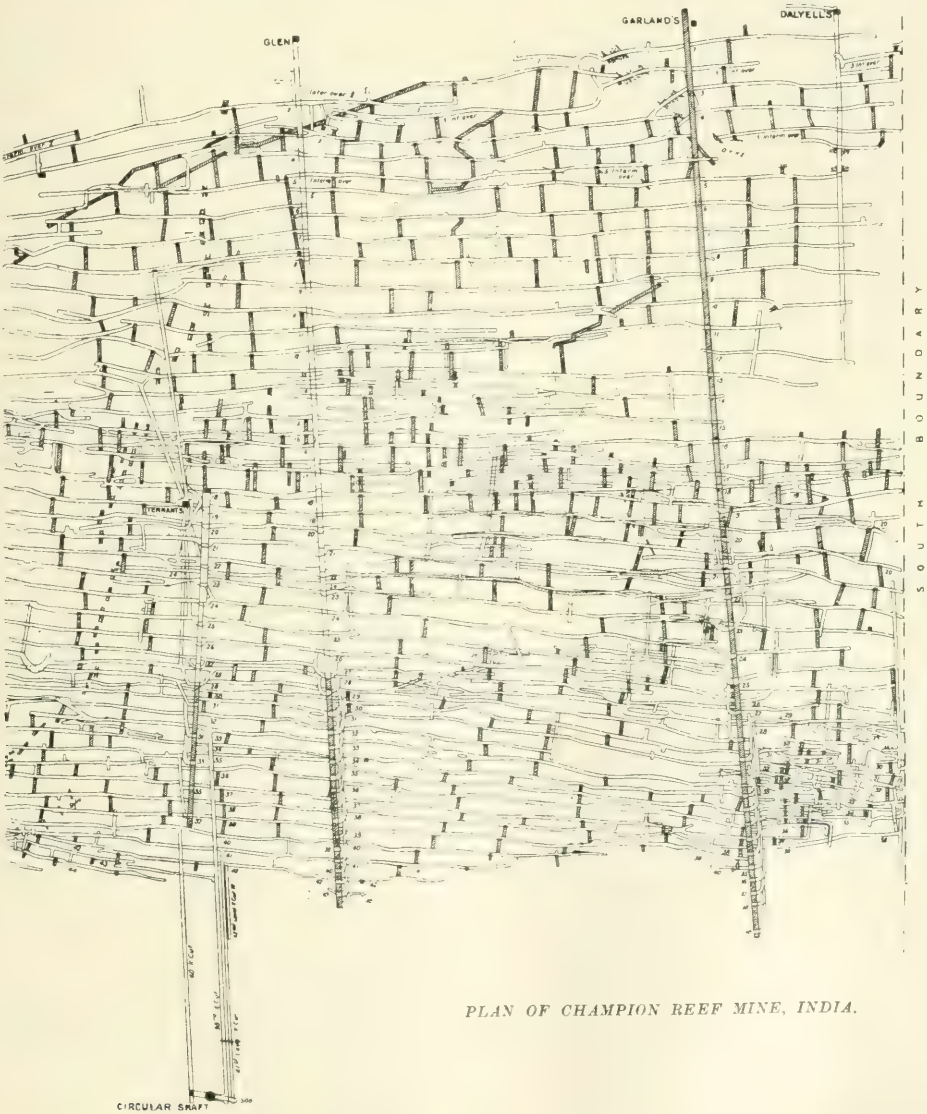
Lena Goldfields.—This company was formed in 1908 by F. W. Baker, in association with the Consolidated Gold Fields of South Africa, to acquire a 70% interest in the Lenskoie company, a Russian organization working unusually rich gold-gravel deposits in the valleys adjoining the Vitim river, a tributary of the Lena, in Eastern Siberia. The earlier history of the company has been recorded already in our pages. It will be remembered that strikes and riots greatly interfered with operations during the year ended September 1912. The report of the Lenskoie company presented to the meeting held in St. Petersburg on September 30 last, showed that the output was 260,505 oz., valued at £979,169, from 549,244 cubic yards, as compared with 430,839 oz., worth £1,619,410, from 861,438 cu. yd. the year before. The drop was caused entirely by the strike. The working profit was £131,300, and against this had to be set £135,796 for losses in connection with the strike, £50,324 for taxes, and £34,074 for amortization of property. To meet these charges £40,821 was brought in from reserve, as was also £49,117 premium on a new issue of shares. It is obviously impossible therefore for the Lena Goldfields to declare any dividend for the year ended September 30 last. Charles M. Rolker, the consulting engineer, reports that during the year ended September 30 last, the output was 335,348 oz., worth £1,251,564, from 820,189 cu. yd. The grade was 7·954 dwt. per cu. yd., as compared with 9·125 dwt. the year before. With regard to the prospective life of the mines, it is estimated that at the chief properties, the Bodaibo group, the North section has an assured life of 7·3 years, and the South of 2·3 years, with further good chances. The new Dogaldin property has been extensively prospected by drills, and gives excellent promise of being a rich producer. The accounts for the year will not be presented in St. Petersburg until next September. C. W. Purington has been making an examination into the methods of mining and of treatment of the men. His report is expected shortly.

Champion Reef.—This company was formed in 1889 by John Taylor & Sons to acquire gold-mining leases in the Kolar district of India, immediately adjoining the Mysore mine. The mine has been exceedingly profitable, the yield to September 30 last having been worth £10,620,037, obtained from 3,179,185 tons of ore; during the same time, £4,018,966 was distributed as dividend. The prosperity steadily in-



PLAN OF CHAMPION REEF MINE, INDIA.

creased until 1905, when £416,000, equal to £160%, was distributed. After that year the quality of the ore decreased, and only 20% was paid in 1908 and 1909. Subsequently, owing partly to slight improvement in the grade, but chiefly to an increased percentage of recovery and to a lowering of the working cost, the dividends have crept upward again, and during the last two years the rate has been 50%. The report for the year ended September 30 shows that 220,511 tons of ore was milled for a yield by amalgamation of 103,797 oz. bullion, and that 339,587 tons of tailing and slime was treated by the cyanide process for a yield of 29,122 oz. bullion, making a total yield of 132,919 oz., equal to 120,510 oz. fine gold, selling for £510,736. The extraction in the battery was $8\frac{2}{3}$ dwt. per ton, and in the cyanide plant 1·46 dwt. per ton. The working cost was £292,735, or 26s. 6d. per ton. In addition, £28,781 was spent on the Circular shaft, £7012 on Tennant's and Carmichael's shafts, and £29,122 on buildings and plant. The shareholders received £130,000, being at the rate of 50%. Developments during the year have on the whole been favourable, particularly in the part between Garland's and Glen's shafts, where a continuous run of ore has been disclosed in the five bottom levels, the 38th to 42nd. South of Garland's shaft the developments have been unsatisfactory, owing to the intrusion of a dike, but there are indications that the ore will be found to the south of the dike at lower levels. In the levels at the bottom of Carmichael's shaft, the lode is narrow, though of high content ; in the 44th and 45th levels the developments are distinctly encouraging. Owing to the occurrence of 'air-blasts' recently, that is to say, sudden disruptions of the rock and lode, it has been found necessary to leave more pillars, and during the year many blocks of ore of lower-grade have been left in place for this reason. The reserve has been decreased by 46,000 tons in this way, but as ore of higher grade has been developed in the meantime, the figures for the reserve on September 30 show no decrease as compared with those of a year ago, the amount being 404,125 tons. The Circular vertical shaft has been sunk to 3861 ft., and the hoisting plant is erected. The equipment of the shaft itself is now in hand. Some time must elapse before the shaft will be brought into commission, as the arrangements for deep working are not yet complete.



PLAN OF CHAMPION REEF MINE, INDIA.

Mount Lyell Mining & Railway.—During the last two years, this celebrated copper-mining company operating the group of mines on the west coast of Tasmania has suffered two misfortunes. First came a wearisome strike. Its effects had barely been removed when the disastrous fire occurred at the North Lyell. The fire broke out in the middle of October 1912, and it was not until August 1913 that the workings were restored to their accustomed state and the output brought to its usual level. The report now issued covers the half-year ended September 30 last. During this time 77,505 tons was raised from underground at the Mount Lyell and 15,392 tons from the open-cut. Of this, 89,661 tons averaging 0·47% copper, 1·83 oz. silver per ton, and 0·78 dwt. gold per ton was sent to the smelter, and 3236 tons was delivered to the sulphuric acid works. At the North Lyell, 36,359 tons was raised averaging 5·97% copper, 1·13 oz. silver per ton, and 0·04 dwt. gold per ton. In addition 255 tons of precipitate was recovered containing 79 tons of fine copper. From the Lyell Comstock, 8544 tons was delivered to the smelter, averaging 3·28% copper, 0·27 oz. silver per ton, and 0·66 dwt. gold per ton. Unfortunately the nature of the orebody and the conditions of mining are such that the Comstock ore cannot be mined at a profit. At the smelter, the production was 2474 tons of blister copper, containing 2442 tons fine copper, 187,097 oz. silver, and 4050 oz. gold. The cost of mining and smelting was 22s. 2d. per ton of blister copper. The ore reserve on September 30 was estimated as follows: At the Mount Lyell, 2,202,335 tons averaging 0·53% copper, 1·96 oz. silver per ton, and 0·55 dwt. gold per ton; at the North Lyell, 1,086,112 tons averaging 6% copper, 1·33 oz. silver per ton, and 0·1 dwt. gold per ton. The Minerals Separation process is being tried in connection with the Comstock and other low-grade ores. The company's South Australian superphosphate business is to be amalgamated with that of the Wallaroo Phosphate Co., in order to avoid unnecessary competition and cost of distribution. The accounts for the period under review show that 2086 tons of copper was sold at an average price of £72. The net profit for the year was £41,943. The direct loss due to the fire was £42,141; of this, half has been charged against the net profit and half to reserve fund.

Great Cobar.—This company was formed in London in 1906 to acquire the Cobar copper mine in New South Wales. The purchase price was £800,000 cash and £206,000 in shares. The capital of the company is £932,710 in 186,542 shares of £5 each, and there are still outstanding £667,300 debentures. The reports on which the business was effected were made by J. D. Kendall, C. M. Rolker, and W. J. Barnett. The Lithgow colliery and the Chesney copper mine were bought at the same time. Three years ago the Cobar gold mine was acquired, the gold-bearing silicious ore of the latter making a suitable flux for the pyritic ore of the Great Cobar. Many difficulties have been encountered in carrying out the expectations of the prospectus. Mistakes were made in the construction and management of the blast-furnaces and other metallurgical plant. The content of the ore has never come up to the original estimate, and now the orebodies are disappearing or becoming narrower with depth. Finally great trouble has been experienced with the labour, which has always been unsympathetic and occasionally defiant. The metallurgical difficulties were removed by H. C. Bellinger, of Montana, who was subsequently made general manager. But during the past year the board decided that he was not as good an administrator and engineer as he was a metallurgist. He has therefore resigned, and has been succeeded by George C. Klug, head of Bewick, Moreing & Co.'s business in Australia. The report for the year ended June 30 shows that 222,377 tons of Great Cobar ore was smelted, together with 45,779 tons from the Cobar gold mine, 8738 tons of concentrate from Chesney, and some purchased ore, making a total of 288,172 tons, from which 5811 tons of copper, 27,136 oz. gold, and 127,543 oz. silver were extracted. The average copper content recovered corresponded to 2·017% of the ore treated. The main shaft at the Great Cobar is down 1515 ft. Attempts at finding the Northern orebody, which was lost below the 10th level, have so far been unavailing. The Central orebody shows a diminution in area on the lower levels, the bottom one being the 14th. A creep in the Southern and Central orebodies has rendered 146,000 tons unavailable for stoping at present. Mr. Bellinger estimates the ore reserve at 1,468,749 tons averaging 2½% copper. At the Cobar gold mine, the reserve is estimated at 308,545 tons averaging 1·7% copper and 6·8 dwt. gold. At the Chesney, the orebody is narrowing with depth; the ore reserve is estimated at 612,986 tons averaging 2·58% copper. Great difficulty has been experienced at the Chesney concentrator, the function of which is to reduce the silicious content of the ore. The ore is first jigged and then treated in the Minerals Separation plant. The re-grinding machines and other details in connection with the jigs were not well adapted to the ore, and the estimated capacity, 700 tons per day, has not been obtained. As the directors felt that they were without a concentration expert, they have recently appointed G. A. Laird to be superintendent of this department. The Minerals Separation plant has been recovering 77% of the material delivered to it. The accounts for the year show a working profit of £81,925, and £34,355 was brought in from the previous year. Out of the balance, £40,009 went to debenture interest, and £57,500 to the purchase of debentures, while £48,414 was written off the account for reorganizing the metallurgical department, an expense incurred a few years ago. During the latter part of the year 1913, W. Pellew-Harvey, one of the directors, paid a lengthy visit of inspection. His report is attached to the directors' report now issued. In many points his views differ from Mr. Bellinger's, and his report should be read in conjunction with that prepared by the latter.

New Zealand Crown Mines.—This company was formed in 1895 by the Exploration Co. to acquire a gold mine adjacent to the Talisman, at Karangahake, in the Hauraki district of New Zealand. Dividends were paid from 1897 to 1903. In 1910 the situation became serious and the control passed to the Consolidated Gold Fields of New Zealand, a company that operates at Reefton. The company was reconstructed and John McCombie, an experienced New Zealand engineer, was placed in charge. Unfortunately the conditions have not improved and another reconstruction is now necessary. The report for the year ended June 30 last contains a recommendation that a new company be formed with the same nominal capital, 500,000 shares of 4s. each, of which 304,650 shares are to be offered to present shareholders credited with 2s. paid, the remainder being left under option at par to shareholders and underwriters; 200,000 out of the 304,650 shares have been underwritten. During the year under review, 19,028 tons of ore was raised and treated, yielding 7671 oz. gold and 8208 oz. silver, worth £33,036. The cost, including depreciation and development, was £37,418. Mr. McCombie reports that during the year all the stoping faces gave poorer results and the number of men was reduced in January. The present scheme for vigorous development has been based on promising indications at a number of points in the mine.

Ida H. Gold. — This company was formed by the North-Waddington group in 1900 to acquire a gold mine in the Mount Margaret district of West Australia. From 1902 to 1906 dividends aggregating 142½% were distributed on a capital of £54,000. Since then no divisible profit has been made, until during the last five months as recorded below. In March 1911 the management was changed, affairs being placed in the hands of Hooper, Speak & Co., whose Australian partner, R. A. Varden, undertook a new campaign of development. The report for the year ended June 30 last shows that development has been actively continued, and though no new orebody has been discovered, the bottom levels present some encouraging features. During the year, 15,253 tons of ore was raised and treated, yielding gold worth £30,996, as compared with 13,007 tons and £36,173 the year before. Concentrate amounting to 719 tons of uncertain content was produced, and shipped to England, with unsatisfactory results. Arrangements are now being made to treat the concentrate on the spot. The present stock of concentrate amounts to 303 tons averaging 41·2 dwt. per ton. The accounts for the year show a loss of £1235. Since the close of the period under review, profits have been made to the extent of £4077 from July 1 to November 30, and the directors have decided to distribute a dividend of 3d. per share on the present capital, £70,581, absorbing £3529. The ore reserve on June 30 was estimated at 10,000 tons, down to the 11th level.

Broken Hill Block 10.—The report of this company for the half-year ended September 30 last shows that 49,174 tons of ore, averaging 11·9% lead, 13·5% zinc, and 9·7 oz. silver per ton, was raised and sent to the mill. The yield of lead concentrate was 6437 tons, averaging 64·6% lead, 6·7% zinc, and 33·6 oz. silver per ton. The lead and zinc content of the ore has been maintained, but the silver is less by 2 oz. per ton than a year ago. The tailing, together with dump material, etc., amounting altogether to 61,700 tons, was dispatched for treatment elsewhere, presumably to the Amalgamated Zinc and the Junction North companies, but the destinations of the various products are not given. The lead concentrator, reconstructed a year ago, is reported to have saved its cost already. The income from the sale of concentrate, tailing, and slime was £91,416, and the net profit was £37,481, out of which £20,000 has been paid as dividend, being at the rate of 4s. per £10 share. The manager, O. B. Ward, gives information relating to the newly discovered Western lode, which is probably a continuation of the lode found 18 months ago in the Central mine belonging to the Sulphide Corporation. This lode has been proved for 100 ft. on the 515-ft. and 615-ft. levels, where it averages 20 ft. wide and assays 13% lead, 9% zinc, and 3½ oz. silver per ton.

Broken Hill Block 14.—The mine belonging to this company is situated between those of the Broken Hill Proprietary and the British Broken Hill. For many years during recent times, operations were confined to removing as much as possible of the argentiferous lead carbonate left in the upper levels, as the reserve of sulphide ore was of too low a grade to warrant its extraction and beneficiation. Two years ago, however, the improvements in the prices of metals and in the methods of concentration warranted the reopening of the sulphide levels. A contract was made with the Junction North company for the sale of the ore to the latter. The report for the half-year ended September 30 shows that the amount of ore mined has increased and that the reorganization underground is being continued. The deliveries of sulphide ore amounted to 16,899 tons, averaging 15·3% lead, 11% zinc, and 10·9 oz. silver per ton. In addition, 6957 tons of carbonate ore, averaging 24·6% lead and 14·9 oz. silver per ton, was raised. The accounts show an income of £45,513 from the sale of ore, and a working profit of £11,294. Out of this, £1823 was allowed for depreciation of plant, £1500 was paid as interest on the 100,000 preference shares of 6s. each, and £10,000 was paid as dividend on preference and ordinary shares, being 1s. on 100,000 ordinary shares of 25s. each and on the 100,000 preference shares of 6s. each. F. Voss Smith is manager.

Sulphide Corporation.—This company was formed in 1895 by the Exploration Co. and Gibbs, Bright & Co., conjointly, for the purpose of acquiring the Central mine at Broken Hill, New South Wales, and to beneficiate the lead-zinc-silver ore by the Ashcroft electrolytic process. Subsequently this process proved a failure and was abandoned, the control passing at the same time entirely into the hands of Gibbs, Bright & Co. After an unsuccessful attempt at magnetic separation, the concentration of the zinc tailing was effected by the Minerals Separation process. The company has in fact been the pioneer of the process in Australia. The whole of the product including the slime is now being treated in a continuous process. The report for the year ended June 30 last shows that 211,593 tons of ore was raised. The average assay is not given, but the silver content is stated to have been well maintained, while the lead and zinc content has been 1·4% and 1% less than during the previous year, owing to a larger amount of ore having been taken from the lower levels. The lead concentrator treated 210,440 tons of ore, for a yield of 32,295 tons of concentrate averaging 67·2% lead, 6·3% zinc, and 33 oz. silver per ton. The tailing, mixed with 3530 tons of old slime, was sent to the flotation plant, where 71,394 tons of zinc concentrate was produced, assaying 43·7% zinc, 10·3% lead, and 17·1 oz. silver per ton. This was re-treated in the de-leading plant, which extracted 2863 tons of lead concentrate assaying 61·4% lead, 13·1% zinc, and 48·6 oz. silver per ton, the zinc concentrate of the remainder being increased from 43·7% to 46%. The total lead concentrate was therefore 35,158 tons averaging 66·8% lead, 6·8% zinc, and 34·3 oz. silver per ton, and the zinc concentrate amounted to 66,518 tons averaging 46% zinc, 8·1% lead, and 16 oz. silver. A year ago it was announced that the accumulated slime was to be sold to the Hydraulic Power & Smelting Co. of Sweden, but this company has not been able to accept delivery; in the meantime the selective flotation processes devised by Lyster and Owen have been perfected, so that the contract for sale has been cancelled and the slime is to be treated on the spot. At the smelting plant at Cockle Creek, near Newcastle, New South Wales, 53,285 tons of lead concentrate, purchased ore, etc., was treated, from which 13,410 tons of lead bullion was produced, containing 53,642 oz. gold and 1,112,265 oz. silver. Difficulty was experienced in buying outside ores owing to European competition, and the amount treated showed a decrease as compared with the previous year. A new sulphuric acid plant has been erected, to utilize the fumes from the roasting operations, and a superphosphate plant with a capacity of 15,000 tons per year has been built. The ore reserve stands at 2,352,000 tons, and comparatively small amounts of new ore have been disclosed during the last few years. The Kintore shaft has been sunk to 1300 ft., and a cross-cut to the lode is in hand. The accounts show a net profit of £280,947, out of which £192,500 has been distributed among shareholders, being at the rate of 20% on both preference and ordinary shares. This compares with 30% the previous year. Out of the balance, £25,000 has been placed to reserve, and £63,447 added to the balance in hand, which now stands at £186,434. The company is awaiting the final appeal in the lawsuit brought by the Elmores for infringement of patents. C. F. Courtney is general manager, James Hebbard is mine manager, and P. S. Morse metallurgist.

Minerals Separation.—The report and accounts of this company controlling the Sulman-Picard-Ballot flotation process covers the year 1912, but Mr. Ballot in his speech to shareholders at the meeting held on December 22 brought the information up to date. The accounts showed an income from royalties of £18,370, and from interest and dividends of £7301. The cost of management was £13,260, and of London administration £4939; £1095 was spent on patent renewals, and £1300 was allowed for depreciation of plant. The net profit was £5090. From funds in hand £49,179 has been allocated to protect the company's controlling interest in the Australian and American companies. The report refers to the two lawsuits on which appeals are pending. The company has made an important advance during 1913 in connection with the Lyster and Owen processes for the differential flotation of galena and blende. During 1913 it is estimated that throughout the world 3,000,000 tons of zinc, lead, or copper ores has been treated, and the estimated figure for 1914 is 4,000,000 tons. The appreciation of the process in America is proved by its adoption at the Inspiration copper mine in Arizona and at the Britannia mine in British Columbia. Contracts have also been made with W. A. Clark, Phelps, Dodge & Co., Amalgamated Copper, and the Guggenheims. The Butte and Superior is producing 11,000 tons of zinc concentrate per month.

Ashanti Goldfields Corporation.—This company was formed in 1897 to acquire from the Cote D'Or Co. property containing gold mines that had been worked superficially by native owners, situated at Obuasi, about 80 miles inland from the Gold Coast, West Africa. Frederick Gordon, of hotel fame, was the moving spirit, and he and his friends found most of the capital in the early days, the consideration therefor being 10% of the annual profits, since reduced to 3%. The capital has been increased from time to time by the issue of shares to the public at high premiums. The high premiums and high quotations on the Stock Exchange were not arranged by the directors, but by the underwriters. For instance in 1900, 10,000 shares of a nominal value of £1 were sold for £10 each, and in 1901, 20,000 shares were sold at £25 each. In 1904, the £1 shares were split into five shares of 4s. each. The present capital consists of 1,071,466 shares having a par value of £224,293. From 1909 onward the profits have been substantial. At the same time many metallurgical improvements were introduced and a new mill was built containing furnaces calculated to remove the graphite and sulphur that had previously interfered with efficient extraction. Another important event of recent years has been the tapping at depth of the shoot of the Obuasi mine from the workings of the Ashanti mine. W. R. Feldtmann is the consulting engineer. The report for the year ended June 30 shows that 148,447 tons of ore was treated for a yield of 107,977 oz. gold, worth £460,530, being an extraction of 14½ dwt. or 62s. per ton. The working profit for the year was £253,116, out of which £23,026 was paid as royalty, £19,968 written off for depreciation, and £39,890 spent on development. The net profit for the year was £175,146. The shareholders received £187,506, being at the rate of 87½%, the same as for the year before. The ore reserve on September 30 was estimated at 365,300 tons averaging 19·4 dwt. per ton, as compared with 392,840 tons averaging 17·7 dwt. per ton the year before. Of the reserve, 49,400 tons averaging 22⅗ dwt. per ton is in the Ashanti mine, 132,900 tons averaging 30¾ dwt. in the Obuasi shoot, 105,000 tons averaging 9½ dwt. in the Ayeinm, and 73,000 tons averaging 11 dwt. in Justice's. During the year, operations have been hampered by scarcity of labour, a condition that is likely to continue and to decrease the rate of extracting the ore.

Tolima.—This company was formed in 1871 to acquire the Frias silver-lead mine in the state of Tolima, Colombia. In the early days large profits were made. Later, in 1903 and 1909, it was necessary to provide new supplies of working capital by reconstruction. During the last three years an improvement has taken place; some of the debentures have been retired and small dividends have been paid. The report for the year ended June 30 shows that prosperity has continued, though the amount of concentrate sold was less than during the previous twelve months, the production having been 884 tons averaging 469 oz. silver per ton, as compared with 1291 tons averaging 505 oz. The accounts show a net profit of £2914, out of which £1621 was spent on the Calamonte mine, on which the company has an option. A distribution of £2500, being at the rate of 2½% on a capital of £100,000, has been declared, out of money in hand brought forward from the previous year. It has been deemed permissible to do this as during the summer the developments at the mine have disclosed large amounts of ore, and since June 30 the monthly shipments have substantially increased. Arthur J. Russell is managing director, and John Russell manager at the mine.

Aporoma Goldfields.—This company was formed in May 1910 to develop the gold-gravel property of the Aporoma Exploration Syndicate, situated in the province of Sandia, in the southeast of Peru. The gravel was worked many years ago by natives and by Spaniards, and their ditches are still to be seen. Merricks, Crane & Co. are the engineers. The history of the present company has been rendered calamitous by reason of the extraordinary climatic variations from long periods of drought to overwhelming flood. The report now issued covers the year ended March 1913. In December 1912, the largest reservoir was destroyed by flood just as the dam was approaching completion. This has since been re-built. Two of the smaller reservoirs have been extended. It is calculated that the water-supply is now sufficient to maintain operations for eight months of the year. A scheme is on foot for bringing a further supply from a point 12 miles away on the river Pacchini, at a cost of £25,000, provided the funds are forthcoming. During the year, little hydraulicking was done; 48,500 cu. yd. of gravel was washed for a return of £1519, which shows a recovery of 7½d. per cu. yd. During the year, £11,180 was spent, and in the balance sheet at March 31 items aggregating £22,000 appear as debts owing. The issued share capital is £252,758. The directors are now proposing to issue 40,000 20% preference shares of £1 each in order to liquidate the debts and provide funds for the new ditch.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Managing Director.

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CONTENTS.

STATISTICS

STOCKS OF COPPER IN ENGLAND AND THE CONTINENT
Reported by Henry R. Merton & Co. Tons of 2240 lb.

	Nov. 30 Tons	Dec. 31 Tons	Jan. 31 Tons
In England	11,993	11,598	10,419
In France	2,487	3,192	1,712
Afloat from Chile	2,050	2,300	3,650
Afloat from Australia	4,950	4,000	3,842
In Rotterdam	2,500	3,750	1,621
In Hamburg	1,785	3,594	1,700
In Bremen	992	1,176	3,000
In other European Ports	1,030	1,050	750
Total European visible supply	27,787	30,570	26,694

AMERICAN COPPER PRODUCERS' ASSOCIATION'S FIGURES.
In Tons of 2240 lb.

	Production.	Deliveries Domestic	Deliveries Foreign	Deliveries Total	Stocks at end of month
Total, 1911	639,258	316,791	337,009	653,800	—
Total, 1912	706,052	365,920	333,212	699,132	—
January	64,053	29,111	26,956	56,067	55,000
February	58,460	26,641	32,219	58,860	54,600
March	60,822	34,190	34,682	68,872	46,550
April	60,416	34,892	38,346	73,238	33,728
May	63,088	36,209	30,477	66,686	30,130
June	54,402	30,559	30,396	60,955	23,577
July	61,640	26,296	35,035	61,331	23,886
August	58,764	32,897	32,706	65,603	17,064
September	58,661	29,837	32,627	62,464	13,261
October	62,085	30,435	30,412	60,847	14,499
November	59,860	21,721	31,280	53,001	21,358
December	62,049	9,794	32,831	42,625	40,782
Total 1913	724,307	342,566	387,974	730,540	—
January 1914	58,826	21,409	39,266	60,675	38,933

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand	Elsewhere	Total	Value
	Oz.	Oz.	Oz.	£
Year 1912	8,753,563	370,731	9,124,299	38,757,560
January 1913	760,981	28,409	789,390	3,353,116
February	702,394	31,728	734,122	3,118,352
March	760,324	30,228	790,552	3,358,050
April	755,858	29,116	784,974	3,334,358
May	761,349	32,957	794,306	3,373,998
June	716,267	30,810	747,077	3,173,382
July	625,107	30,282	655,389	2,783,917
August	697,686	30,410	728,096	3,092,754
September	676,411	29,775	706,186	2,999,686
October	687,515	30,916	718,431	3,051,701
November	644,320	29,166	673,486	2,860,788
December	642,786	30,029	672,815	2,857,938
Year 1913	8,430,998	363,826	8,794,824	37,358,040
January 1914	621,902	29,851	651,753	2,768,470

COST AND PROFIT ON THE RAND.

	Tons	Yield per ton	Cost per ton	Profit per ton	Total profit
		s. d.	s. d.	s. d.	£
Year 1912	25,486,361	29 2	19 3	9 11	12,678,095
January 1913	2,296,948	27 8	18 0	9 9	1,113,579
February	2,100,137	27 11	18 3	9 9	1,019,774
March	2,321,254	27 5	17 8	9 8	1,121,786
April	2,301,099	27 6	17 11	9 7	1,101,099
May	2,366,726	26 11	17 7	9 4	1,099,397
June	2,177,354	27 6	17 8	9 9	1,061,507
July	1,873,980	27 6	19 4	8 3	785,263
August	2,162,807	27 1	17 7	9 6	1,026,851
September	2,035,318	27 9	17 10	9 10	1,002,228
October	2,073,909	27 6	17 9	9 8	996,515
November	1,955,573	27 6	17 11	9 7	931,145
December	1,976,327	27 4	17 10	9 6	929,966

GOLD OUTPUT OF INDIA.

Year 1912	Year 1913	Jan. 1913
£2,265,094	£2,299,315	£193,140

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold mines	Coal mines	Diamond mines	Total
January 31, 1913	200,090	8,789	13,912	222,791
February 28,	207,662	8,877	13,918	230,457
March 31	207,733	9,009	15,041	231,783
April 30	205,424	9,053	15,626	230,103
May 31	197,644	9,062	15,345	222,051
June 30	188,094	9,060	14,654	211,808
July 31	170,242	9,403	13,378	193,023
August 31	158,223	9,236	13,172	180,631
September 30	152,637	9,361	12,321	174,319
October 31	148,882	9,377	12,712	170,971
November 30	147,569	9,286	12,680	169,535
December 31	150,012	9,516	11,811	171,339
January 31, 1914	154,202	9,471	11,979	175,652

PRODUCTION OF GOLD IN RHODESIA.

Year 1910 £	Year 1911 £	Year 1912 £	Dec. 1913 £	Year 1913 £
2,568,201	2,647,894	2,707,368	254,687	2,903,267

PRODUCTION OF GOLD IN WEST AFRICA.

Year 1911 £	Year 1912 £	Dec. 1913 £	Year 1913 £
1,069,442	1,497,179	127,472	1,634,700

PRODUCTION OF GOLD IN WESTERN AUSTRALIA.

	Export oz.	Mint oz.	Total oz.	Total value £
Total, 1910	363,496	1,209,856	1,573,352	6,682,042
Total, 1911	160,021	1,210,447	1,370,468	5,823,522
Total, 1912	83,589	1,199,080	1,282,669	5,449,057
Total 1913	86,255	1,227,888	1,314,143	5,448,332
January, 1914	9,762	102,261	112,023	475,840

OTHER AUSTRALASIAN GOLD PRODUCTION.

	1911	1912	Dec. 1913	1913
		£	£	
Victoria	2,138,000	2,039,400	171,200	1,847,400
Queensland	1,623,390	1,484,160	95,200	1,118,640
New South Wales	769,353	702,129	57,914	635,703
New Zealand	1,808,049	1,345,115	218,411	1,345,131

NIGERIAN TIN PRODUCTION.
In tons of concentrate of unspecified content.

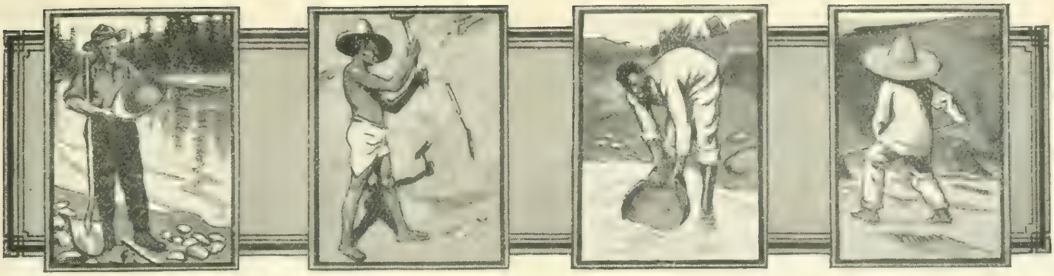
Year 1912 tons	Oct. 1913 tons	Nov. 1913 tons	Dec. 1913 tons	1913 tons
2,532	480	446	478	5032

SALE OF TIN CONCENTRATE AT REDRUTH TICKETINGS.

	Tons	Value	Average
Year 1911	6151¼	£702,599	£114 4 5
Year 1912	6492	£831,908	£128 5 6
Year 1913	6186	£744,268	£120 2 6
January 5, 1914	202¼	£18,743	£92 13 6
January 19	232¼	£23,045	£96 6 6
February 2	231	£24,054	£104 2 7

EXPORTS OF TIN AND ORE FROM STRAITS AND BOLIVIA.
Reported by A. Strauss & Co.

	1912 tons	1913 tons	Jan. 1914 tons
Metal from Straits to Europe and America	59,036	62,533	5,235
Metallic Content from Bolivia to Europe	21,149	24,843	1,704



REVIEW OF MINING

INTRODUCTORY.—When last we went to press the big strike in South Africa had begun, the markets were acutely depressed, and business was in a parlous state. Since then a complete change has supervened; it is as if a warm air had melted the crust of winter and awakened the life beneath the surface. The strike collapsed, and with it a menace to South African industry. A reduction in the Bank rate to 4% indicated a good supply of money, and when the rate was further reduced to 3%, the currents of speculation were loosened. New issues have been over-subscribed. Shares and bonds have risen in lively fashion. The share-list, published on page 140, exhibits how general has been the rise in the mining market. Apart from more cheerful conditions, the slackening of trade is causing a diversion of capital from manufacture and commerce to speculation. If only the Mexican tangle could be straightened, we might expect a widening of activity. Meanwhile, two or three large Rhodesian mines are making their first crushings; whether good or bad, the results are sure to attract attention to that discredited mining region. Broken Hill shares continue good, on promising developments underground and a satisfactory price for lead. Russian issues have been stimulated by the Russo-Asiatic developments. The shares of Rand mining companies, of course, have benefited from the clearing of the air in South Africa. Tin enterprises in the Malay States continue to engage public interest. The Kirkland Lake flotations have been of a meretricious character, but they do indicate the development of a new and highly promising gold-mining district in Canada. Speaking generally, the tide has turned, after a long ebb, and business has undergone a marked revival.

TRANSVAAL.—The production of gold in January, 651,753 ounces, shows the effects of the recent disturbance, but the decrease, as compared with December, is only 21,062 ounces. On the other hand, the supply of native labour has increased by 4190, making the total 154,202 as compared with 200,090 a year ago.

The Chamber of Mines' estimate of the life of the Rand is vitiated by the incorrect assumption of 18·61 shillings as the average working cost in 1912. That is the nominal or theatrical cost; the real cost is obtained by subtracting the dividends from the yield, according to which the cost in 1912 was 22·2 shillings per ton. The so-called profit made by the mines of the Rand in 1912 was £12,434,340, but only £7,998,790, or 64% of it reached the shareholders. In 1913 the so-called working cost was 17·9s. as against the actual cost of 21·2 shillings per ton. For the last three years the ratios have been as follows:

	1911	1912	1913
Tons	23,888,260	25,243,143	25,381,934
Yield	£33,543,479	£35,980,194	£35,045,835
Nominal cost per ton	18·5s.	18·6s.	17·9s.
Real cost per ton	21·5s.	22·2s.	21·2s.
Total nominal profit	£11,414,863	£12,434,340	£12,348,016
Total dividends	£7,755,997	£7,998,790	£8,111,310
Percentage of nominal profit distributed	68	64	65·7

It is stated unofficially that the annual report of the East Rand Proprietary will show a decrease of 450,000 tons in the ore reserve, which was 6,013,300 tons of 6·8 dwt. ore at the end of 1912.

Our Johannesburg correspondent refers to the Modderfontein Deep, which is developing most satisfactorily. At the end of 1913 the reserve consisted of 982,000 tons of developed ore and 191,000 tons of partly developed ore, making 1,173,000 tons averaging 7½ dwt. over a stoping-width of 73 inches. The first shaft reached the banket in August, 1912, so that development has been extraordinarily rapid. The mill, able to treat 30,000 tons monthly, is expected to be completed by the end of the present year.

Mr. Aubrey Hyman has extended his campaign against the Robinson-Crown Mines consolidation by going to Paris, where, however, he has been encountered by Mr. Fernand Robellaz, who has given forth an interview in which sundry salient facts are clearly stated. It is a pity that they were not given to the shareholders in the first instance.

On February 5 it was stated officially that the scheme was to be abandoned owing to the opposition developed, and that the directors of the Robinson would tender their resignation at the next annual meeting.

The Geduld makes a good development showing at the end of 1913, the reserve having increased from 1,475,000 tons to 1,757,000 tons without any decrease in grade, which remains just under 7 dwt. per ton for a stoping-width of 4½ feet.

The Consolidated Gold Fields dividend, equal to that of February last year, created a pleasant impression on the market. Future prospects depend on the American subsidiary, which is doing well, we believe.

A commission appointed to consider the question of Sunday observance has reported in favour of stopping operations in the mills of the Rand on Sunday. The 15% loss of time would entail a reduction of only 4% of the total stamps now at work. It is suggested that three years should be given for the necessary preparations for Sunday stoppage.

RHODESIA.—The output of gold in December was excellent, namely, 60,554 ounces, bringing the total for the year to £2,903,351, which is the highest recorded, although it is only £196,000 more than in 1912. During the last four years, the output has increased less than £500,000, which is disproportioned to the amount of capital raised for Rhodesian gold mining, although, of course, only a small part of it has been actually expended at the mines. The next few months should see a notable increase of production, owing to the commencement of milling at the Cam & Motor, Shamva, and Falcon mines.

The Lonely Reef, which, according to the chairman, Mr. C. F. Rowsell, was gaining progressively in richness with depth, continues on the down grade. The reserve of ore at the end of 1913 was 172,557 tons, assaying 17·1 dwt., as against 174,529 tons of 22·4 dwt. ore at the end of 1912.

In regard to the Tanganyika Concessions, a recent letter from Mr. Robert Williams has been published, stating that the two furnaces are running steadily and producing at the rate of 1000 tons of copper ingots monthly. Four more furnaces are to be added to the plant, so as to double the output by the end of 1915; but our understanding is that the supply of fuel, when the coke-ovens are completed, will suffice for three furnaces only. It is claimed that the general manager's previous estimate of the cost of producing copper has been "borne out," namely, £37 per ton delivered in Europe. But the estimate on which former forecasts of production were based was £25 per ton, as given by Mr. Allan Gibb in 1909. However, £37 marks an important decrease in cost. The negotiations for raising money to complete the Benguella railway are proceeding satisfactorily.

WEST AFRICA.—The last month of 1913 showed a slight decrease in gold production, to £127,472, making the total £1,634,700 for the 12 months. This is the largest annual yield, but it is only £137,521 more than the previous year. The Abbontiakoon did not do as well as in November, the yield falling to 37s. 8d. per ton, and to this fact is owing the decrease in the aggregate production.

Mr. H. F. Marriott's report on the Prestea settles several disputed points. At the annaul meeting in June 1911, the chairman, Mr. Edmund Davis, a great student of the share-market, stated that the mine could supply 30,000 tons per month for the 110-stamp mill when completed at the end of that year, although the manager afterwards informed the board that the mine was not in a condition to supply more than 15,000 tons. In December 1913 the Prestea mill treated 20,490 tons. Mr. Marriott concludes that "the maximum economical rate at which the mine should be worked is about 25,000 tons per month." This tonnage is to be attained shortly. On an average crushing of 19,000 tons the cost has been 25s. per ton ; when treating 25,000 tons monthly, the cost will be reduced to 23s. per ton. The profit will be 10s. per ton milled. As the reserves average 41·9s. per ton, for 703,000 tons, it is obvious that Mr. Marriott means ultimate or real profit, not that elusive 'working profit' that has been the undoing of legitimate mining in West Africa. As the real profit is to be 10s. and the cost 23s., the loss in milling must be 8·9s. per ton.

Despite the incidence of the dry season, the output of tin from the Nigerian mines showed an increase in December, as compared with November.

The dredge on the Jos placer started work in October, but has not got into its stride even yet. In the report no explanation is given, but we understand that difficulties have arisen owing to the use of internal combustion oil-engines instead of the usual steam plant. The consumption of oil has averaged 65 lb. per hour of actual operation. The dredge itself has worked well, winning 5·48 lb. of 70% concentrate per cubic yard. The best run was 324 hours and 10,150 cubic yards in December. Results from the Benue dredge are lacking, because there also difficulties have arisen.

INDIA. — Development in depth at the Champion Reef continues to give highly encouraging results in the Glen, Carmichael, and Garland sections. At eight different points ore containing more than 2 ounces per ton over widths averaging about 2 feet has been found. In the Anantapur district, the lowest level (at 650 feet) of the North mine is in a wide shoot of ore assaying $2\frac{1}{4}$ ounces across the face, 5 feet, the full width of the orebody not yet being ascertained. The mill at the Jibutil was started in December, but owing to delay in provision of power it is not being run at more than half capacity. The yield for January was 245 ounces bullion from 1010 tons of ore. The mine-assays indicate an average content of 9 dwt. per ton. No doubt the figures for content and extraction will be closer when the amount of gold held in the plant reaches its maximum.

AUSTRALASIA. — Our Melbourne correspondence is delayed in transmission. At Broken Hill a proper feeling of optimism is in evidence. Prices for lead, discoveries of ore, and metallurgical improvements have all been highly satisfactory. The shortage of lead from Mexico is helping Broken Hill, for imports of Mexican lead to the United States have decreased from 20,220 tons in 1911 to 10,380 tons in 1913.

An official announcement has been made forecasting "an amalgamation of interests in so far as smelting and refining operations are concerned" between the Broken Hill Proprietary and its neighbours, the North and South companies. This is an important step and should prove beneficial to all concerned.

Mount Elliott has been sustained by the impending scheme for an amalgamation of the Queensland Copper Freeholds with sundry other properties in the Cloncurry district. The

Mount Elliott is to provide working capital for the new company, taking a large block of shares as consideration. The result, it is said, is " to vivify scrip at present difficult to negotiate."

Great Cobar shares have fluctuated from 5s. 6d. to 22s. according as bears were hit by rumours of reorganization or assessment. Mr. G. C. Klug, the new manager, has shut-down the concentrating mill and is doing as best he can with selected smelting ore, earning enough thereby to meet the debenture interest becoming due.

Good news comes from the Progress mine, belonging to the Consolidated Gold Fields of New Zealand, for a cross-cut on the 10th level has exposed 18 feet of ore assaying 19½ dwt. gold and 10 feet more assaying 10 dwt. per ton. This is extremely important because the ore-channel has not hitherto been found under the big south dike that traverses the workings. The 2½ years search for the extension of the lode has now been rewarded by a discovery that is likely to prove crucial.

A collapse of the main or No. 4 stopes in the Victorious mine has compelled the Associated Northern company to stop milling. Last August a creep in the upper levels gave a warning of this mishap. Mr. E. H. Liveing regards the prospects of the mine as " meagre."

CANADA.—Occasional references to Bewick, Moreing & Co's connection with the Hollinger still appear in the Canadian press. It is usually suggested that Mr. C. A. Moreing and his associates bought a block of Hollinger shares and sold them shortly thereafter, whereas the Timmins brothers expected that these shares would be retained as an investment. We are informed that Mr. Moreing, for the Northern Ontario Exploration Co., was offered a block of Hollinger shares to make a market in London. He took them on that understanding, and fulfilled the purpose intended. As Bewick, Moreing & Co. were appointed London agents for the Hollinger company, the transfers bore the firm's name. This led the Canadians to think that Bewick, Moreing & Co. had owned the shares and had sold them. The shares had been sold, as understood, by the Northern Ontario Exploration Co. to sundry purchasers in London, not by Bewick, Moreing & Company.

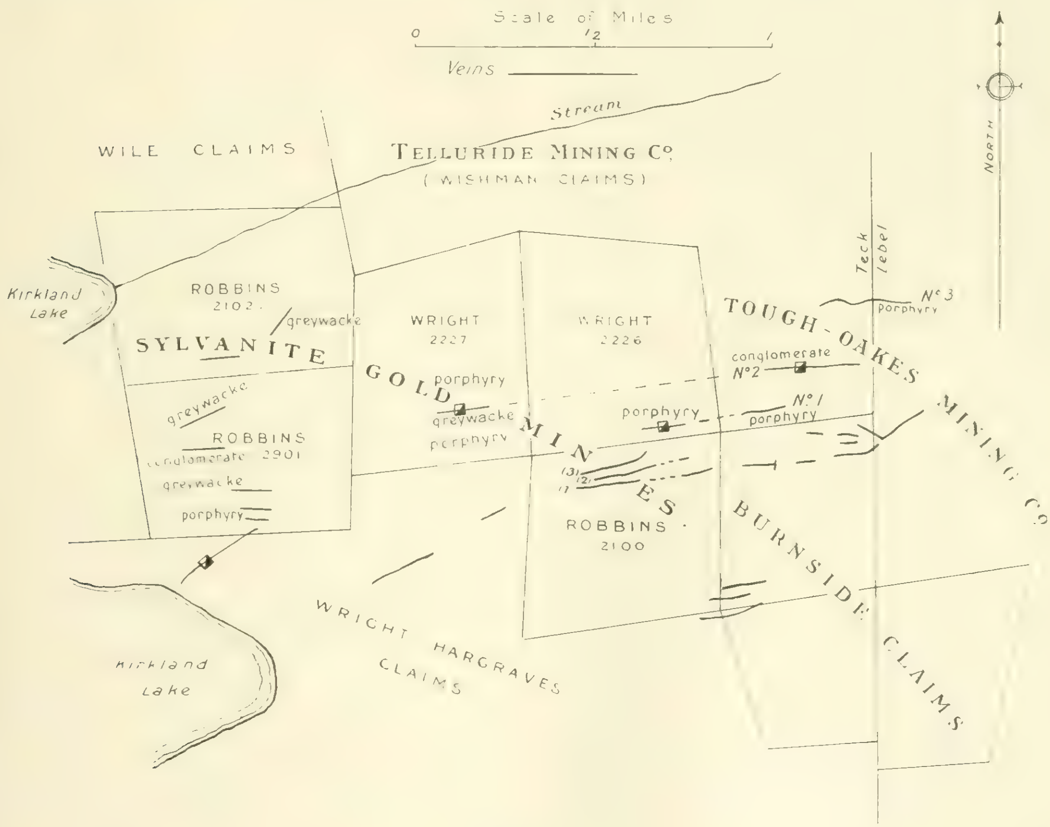
The Kirkland Lake district has been conspicuous lately. We give a map on the opposite page showing the position of the various claims, with a few geological notes. The Tough-Oakes is named after Jim Tough and Harry Oakes, two prospectors. The Teck-Hughes is the deepest prospect, and is down to 300 feet; it is situated just west of the edge of the map.

We note with approval that the Casey Cobalt and the Cobalt Townsite companies have decided to discontinue the publication of weekly estimates of output; instead they will give actual returns monthly. When working high-grade ore it is undesirable to estimate smelter returns in advance. Incidentally, we do not like estimates on the resources of 120 acres made on the basis of a selected tract of 4 acres. Mines are not measured on acreage. This is the only blemish in Mr. W. R. P. Parker's excellent speech at the Casey Cobalt meeting.

UNITED STATES.—Our San Francisco correspondent refers to the bill before Congress enacting the construction of a railway in Alaska by the Government. This has been passed. It should prove a great stimulus to mining activity in that part of the American continent. According to telegraphic advice, the American Smelting & Refining Co. is to be subjected to proceedings under the Anti-Trust law. This, if successful, would have a far-reaching effect on American and Mexican mining enterprise.

Clay in the gravel has impeded dredging operations on the Pato concessions of the Oroville Dredging Company. The yardage has fallen to less than half the capacity of the dredge, which dug 28,000 cubic yards in the week ending November 25. As regards working cost, we have made inquiry and find that no estimate of the total cost (the only figure of real significance) has been given officially because the varying character of the ground to be dredged renders it difficult to estimate accurately the cost of digging; furthermore, the interest on capital borrowed for the dredge and construction work has to be kept in mind.

A circular, issued on January 28, announced that the directors of the Oroville Dredging company have decided to make another company for the San Francisco property. This seems unnecessary; the Oroville holdings will then be in the hands of three companies, entailing a multiplication of overhead expense. The new one is to be called the Nechi Mines, and will take over the 400 acres already acquired, with a capital of £140,000, in an equal number of preferred and ordinary shares of 10s. each. The ordinary shares will be allotted, fully paid, to the vendors, the Oroville Dredging company, in part payment of the purchase, the balance of £20,000 being paid in cash. The preferred shares will be offered to the Oroville shareholders. It is estimated that a 9-ft. bucket-dredge, digging the 90 acres already tested, will earn at least £120,000 per annum. All of which is most encouraging to the shareholders.



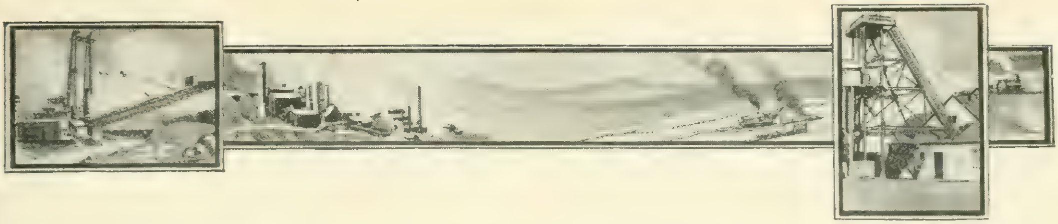
KIRKLAND LAKE.

MEXICO.—The month has passed without any notable improvement. It is true President Wilson has lifted the embargo upon the importation of arms and ammunition from the United States, but we fail to appreciate the wisdom of this step. It seems to us likely that these munitions of war will be used against American troops when the inevitable intervention happens. Meanwhile, we note with pleasure that the *Times* correspondent in Mexico has finally killed the oil rivalry myth, according to which Pearson's and the Standard Oil were at the bottom of all the recent revolutions, in an effort to retain control of the oil industry, the one supporting Huerta and the other Madero. It is a myth, and the killing of it will remove one hindrance to an understanding of the real conditions.

RUSSIA.—The Office of Mines is preparing a bill imposing an obligation to maintain a fixed minimum output from undeveloped claims on Crown lands. The object is to force into active production a large number of properties at present idle. This ought to prove helpful to the acquirement of claims by foreign capitalists.

The statements made at the Russo-Asiatic meeting were extremely interesting, for they indicate that a big mineral discovery has been made. The scene of it is the Ridder or Riddersk mine in the Altai, where ancient workings, made by the Tschuds, gave evidence of former productivity. The last work done by the Russians was in 1867 as regards smelting, and about 1895 as regards gold milling. Attracted by the statistical records, which showed a big output of lead and silver, the Russo-Asiatic company's engineers made an investigation and then started two bore-holes, now known as A and C. These have penetrated a lode of enormous dimensions. Borehole A shows 23 feet of solid sulphide ore, assaying 29% zinc, 19% lead, 2% copper, 8 oz. silver, and 17 dwt. gold from 267 to 290 feet in depth ; this is followed, from 290 to 390 feet, by 100 feet of disseminated sulphide ore, assaying about 5% lead, 10% zinc, 2 oz. silver, and 15 dwt. gold ; this again, from 390 to 512 feet, is followed by 122 feet of ore carrying 11 dwt. gold. We understand that this last part of the lode carries from 2 to 5% of zinc and lead sulphides. Tests suggest that it can be cyanided. From 512 to 531 the bore penetrated a dike, and thence to 596 feet the rock is a lower grade repetition of the gold ore, averaging about 8 dwt. gold with traces of sulphides. Thus the lode is 300 feet thick. The C bore-hole is 250 feet south of the foregoing ; it cut the lode at 258 feet and passed through sulphide ore for a thickness of 200 feet, at the date of last advice. The first 28 feet assayed 4% lead, 11% zinc, 4 oz. silver, and 2 dwt. gold ; the next 42 feet assayed 1% copper, 17% lead, 28% zinc, 12 oz. silver, and 12 dwt. gold ; then came 42 feet assaying 1½% copper, 19% lead, 36% zinc, 15 oz. silver, and 7 dwt. gold. Further assays are on the way, but it is reported that 28 feet more of solid sulphide ore has been cut, besides 58 feet of disseminated sulphide, resembling that in bore A. The dike also has been cut, so that the results harmonize, except that C is better than A. Two more bores have been started and a metallurgical testing plant is being shipped. On a Broken Hill basis this lode is richer in lead and zinc, about the same in silver, while the gold is clear gain.

VARIOUS.—Among recent issues, we note the Anatolia-Serdjiller Syndicate, organized to explore sundry ancient workings in Asia Minor, in a locality only 25 miles from the Dardanelles. A report made by Mr. E. R. Woakes, for John Taylor & Sons, affords evidence of ancient gold mining operations on a large scale, despite the extreme hardness of the rock. It is believed that the Serdjiller workings indicate the site of the Astyra, which, according to prehistoric tradition, was a gold mine worked by Priam of Troy. The lode is a quartz vein 40 to 50 feet wide, outcropping boldly for half a mile. Excavations extend to a depth of 300 feet. An incline shaft will be sunk, and if results are encouraging an adit will be driven from the small valley at the foot of the hill traversed by the vein. The capital of the syndicate is only £25,000, and the operations will be directed by John Taylor & Sons.



EDITORIAL

As Mr. Dooley, of New York, said to Mr. Hennessy: "Whin a counthry loike Mexico is so contagious to us we're liable to get it whether we want it or not."

From this date our offices will be in rooms 722 to 724, in Salisbury House, and on the floor below our former headquarters. The new premises are those vacated recently by our friends of the Institution. Like most progressive people, we have made a change for the better, but the goodwill of *The Mining Magazine* is not circumscribed by walls or plant; it is broad as the trail of the miner is long; we base the success of the first five years and our hopes for the future on the support of the mining profession, which is doing the world's work in every corner of the earth's surface and in the waters under the earth.

In the death of Strathcona there passed one of the great empire-builders. We drop his title because before the majesty of death all suffixes and prefixes are trivial. He ennobled the House of Lords. By a combination of the business instinct with the constructive imagination he accomplished during his life-time enough to give distinction to half-a-dozen men. Donald Smith was a great, good, and useful man.

Elsewhere in this issue we refer to the Royal School of Mines dinner, which is to take place at the Café Monico on March 18. Tickets at 10s. 6d. can be obtained from the Hon. Secretary, Mr. T. A. Rickard, 724, Salisbury House, E.C. This dinner will be the first of the Royal School of Mines Association, and the 41st of the Old Students. Professor William Gowland, A.R.S.M., F.R.S., the President of the Association, will be in the chair, and among the guests will be the 48 fourth-year students now at the Royal School of Mines, all of whom have been invited to meet the older graduates on this auspicious occasion. A large and representative attendance is expected.

If the Kirkland Lake companies are to command public confidence, and be something more than Stock Exchange counters, they must shed their Rhodesian affiliations. When we saw the circular signed by the Union and Rhodesian Trust, Limited, as "secretaries" of the Canadian company, we felt a jar. It seems incongruous and intensely undesirable to extend the methods of Rhodesian finance to a new and promising district in Ontario.

We note with interest that Mr. Rowland Feilding has become a frequent contributor to the financial supplement of *The Times*. His criticism of mining affairs appears to us to be sound, while his writing has an urbanity and restraint quite in keeping with the style of the great newspaper with which he has identified himself. We welcome sound views on mining anywhere, but especially in a great organ of thoughtful opinion.

Royal School of Mines men are making history just now. We refer elsewhere to Mr. Creswell as a labour leader in South Africa. Now comes Colonel Oscar

Benavides, another R.S.M. man, who led the military assault on the presidential palace at Lima, and completed a revolution.

WE PUBLISH a timely and interesting article on the geology of Cobalt by Mr. J. Mackintosh Bell, Ph. D., Harvard, formerly on the Canadian Survey, and subsequently Director of the Geological Survey of New Zealand. Mr. Bell writes as one having authority and not as the scribes.

EXPERIENCE on the Rand is a poor preparation for valuing mines elsewhere. The comparative regularity and low grade of the banket deposits renders them quite unlike the high-grade irregular orebodies characteristic of other districts. To compare 70 dwt. gold ore at Kirkland Lake with 7 dwt. ore on the Rand is grossly misleading, unless it is stated that the tonnage in one case is forty or fifty times greater than in the other. Moreover, the cost per ton and percentage of recovery cannot be ignored. Comparisons based on assays only should not be made by intelligent engineers.

ANYBODY reading the speech of Mr. Oliver Wethered, at the Rayfield meeting, will get a good idea of the optimism on which the better kind of mining adventure has been started, and advanced, in Nigeria. To pay £40,000 in dividends and then to turn round and borrow £50,000 in 6% debentures, guaranteed for a further 5%, is not sound finance, but it is not claimed to be such. To expand the business of a small Nigerian syndicate until it becomes an agency for making half a dozen other flotations in Cornwall and Nigeria is an accomplishment quite in character with the cheerful personality of the chairman. We make these remarks in no unkindly spirit, for mining owes much to men of his unsparing energy. The Rayfield in Nigeria has done well, thanks largely to the late Walter Wethered and to the manager, Mr. J. M. Iles, both of whom have worked earnestly to make the enterprise an admitted success. But we do think, in his own interest and in that of his supporters, that Mr. Wethered might abate his promoting impetuosity until some of his numerous recent ventures have come to fruition. To have to raise money on debentures for a young and productive mine indicates an extravagance that needs to be checked even when incurred by a man of apparently inexpugnable youthfulness of spirit.

NEXT YEAR the centenary of the Treaty of Ghent is to be celebrated, because it marks the end of 100 years of peace between England and America. The occasion is well worthy of emphasis. At the Mansion House meeting on February 4 we heard the Archbishop of Canterbury, the Premier, and Lord Bryce speak eloquently on a subject so appealing to thoughtful men on both sides of the Atlantic. It is proposed, among other things, to found an Anglo-American professorship of history in order to give a less partisan treatment to the 20 years when Englishmen disagreed on taxation and self-government. Another result will be to make better known such men as Alexander Hamilton and Abraham Lincoln, whom the Anglo-Celtic race is glad to honour, without reference to the ferry-crossing that now separates two divisions of it politically. We intend to keep the peace with our friends in America, anyway.

BY the issue of another annual volume of the 'Directory of Directors,' we are reminded again of the preposterous number of directorships held by some individuals. Mr. Edmund Davis is a director 36 times, while Mr. Hugo Cunliffe-Owen, Mr. D. B. Hanna, and Sir S. W. Furness are directors in 30 companies. Seventeen men hold more than 22 directorships apiece. It is plain to any reasonable man that no human being can discharge such duties efficiently if he scatters his energies among so many enterprises.

THE Jos report speaks concerning "some" 210 tons of tin oxide assaying "in the neighbourhood of" 75%, and "some" $37\frac{3}{4}$ tons of concentrate won from the Ropp area, while "some" 3 tons $7\frac{1}{2}$ cwt. of tin concentrate was recovered by dredging. In each case 'some' is meaningless; it is a vulgarism usually signifying 'about;' but when the output is given to quarters of a ton and halves of a hundredweight, it becomes a weary affectation. Meticulous precision is objectionable, but pretentious inaccuracy is equally out of place in technical statements.

HARVARD UNIVERSITY and the Massachusetts Institute of Technology have agreed to co-operate in educational work and to join forces in the scientific training to which hitherto these two great organizations have applied themselves separately. The co-operation, as yet, is limited to engineering in its varied aspects, including mining. It is agreed that all the work of education and research in these branches of applied science shall be done within the walls of the new buildings of the Institute to be erected in Cambridge, and, on the other hand, that the faculty of the Institute shall be enlarged by the addition of the professors, assistant professors, and associate professors in the four departments of the Harvard schools of applied science, who, while retaining their titles and privileges in the University, will acquire corresponding titles and privileges in the Institute. Similarly, the officers of corresponding rank in the four departments of the Institute will acquire the same status in the University. The work of instruction will be entrusted to this enlarged joint faculty. Thus the old rivalry will be quieted, and the Charles river will cease to divide competing forces. As to which gains most, it is not worth while to ask, for those responsible, chiefly the president of the University, Mr. A. Lawrence Lowell, and the president of the Institute, Mr. Richard C. Maclaurin, have approached the solution of a difficult problem in no parochial spirit, their object being the welfare of the community as a whole and the general advancement of technical education in America.

AMONG the regrettable incidents of the strike in South Africa was the arrest of Mr. F. H. P. Creswell for promoting disaffection and dissuading other people from working. He was convicted, but the sentence was subsequently remitted by the Government. Mr. Creswell is an Associate of the Royal School of Mines (1885-1888) and a man of high intelligence; he has taken the side of labour and become an influential leader of the Labour party in South Africa. Undisciplined sentimentality for the worker and an intense dislike of the financial controllers of the Rand mining industry have caused him to become one of the victims of the late unpleasantness. We believe that the workers in South Africa, as elsewhere, have real grievances, which need to be corrected, but the general strike, plus intimidation, by dynamite or otherwise, is not the way to do it. The State cannot be terrorized if civilization is to persist.

The Institution as a Freeholder.

Any observant person happening to be in Finsbury Circus in the late afternoon of January 13 would have remarked a small crowd standing outside an unpretentious building on the corner of West Street; he would have noticed an awning designed to protect visitors arriving in carriages, and he would have seen that the road-way in front was neatly sprinkled with red sand, to mitigate the slipperiness of the London pavement. Joining the crowd he would be impressed by three stalwart policemen, symbolic of that respect for law and order that is the basis of our civilization.

Meanwhile, numerous dark-coated pedestrians will have passed under the covered way into the house at No. 1 Finsbury Circus, and while our supposed intelligent observer, from New Zealand perhaps, like Macaulay's friend, was wondering what was happening, he will have been requested to move aside as the clatter of horses was followed by the appearance of the resplendent equipages of the Lord Mayor and one of the Sheriffs of the City of London. They halted, in turn, while the Lord Mayor, Sir T. Vansittart Bowater, and Mr. Sheriff Humphery alighted, to pass indoors. Here we leave our observant New Zealander, and enter the building ourselves. When the Lord Mayor arrived, he was received by the President of the Institution of Mining and Metallurgy, Mr. Bedford McNeill, who was supported by the President-elect, Mr. Frederick H. Hatch, the Treasurer, Mr. Edgar Taylor, and the Secretary, Mr. Charles McDermid. After the usual polite greetings, the party adjourned to the council-room, where a large number of the members had gathered to witness the ceremony that was to mark the formal opening of the new home of the Institution. The President opened the proceedings by a felicitous speech, the full text of which we give on another page.

The most significant point made by him was that the Institution now became a freeholder in the City of London; and the point was seized by the alert Lord Mayor, who made a supplementary speech in acknowledgment of this salient fact, to which he addressed himself in terms of complete sympathy, ending with the formula of the ancient livery companies of London: "May this Institution flourish, root and branch, for ever." To us as a chronicler of the time it seems that this feature of the new departure cannot be overestimated. The Institution of Mining and Metallurgy is now the owner of a freehold home in London, in the very heart of the City, and close to the quarters where mining men most congregate. The genial president might exclaim: *Nous sommes arrivé!* After years of honourable effort, by growth of membership, gain in prestige, and expansion of worldwide endeavour, the Institution has won its own place, safe from the buffetings of circumstance, and now stands an accomplished fact of the greatest significance not only to the profession, of which it is the corporate representative, but also to the multifarious and worldwide business of mining, the chief financial centre of which is the metropolis of the Empire, with all its Overseas Dominions.

Kirkland Lake Flotations.

The first of these made its appearance early in January with a statement, in lieu of prospectus, couched in terms of studied obscurity. However, it promised a lively gamble and won the support of those on the fringe of the Stock Exchange. The shares have risen since to a big premium, from £1 to $2\frac{7}{8}$. On January 15 the report of Mr. H. H. Johnson was published. This deals with the company's chief asset, an option on the Tough Oakes mine, subsequently the basis for a subsidiary flotation. We have read Mr. Johnson's report with regret. It is a pity that he, as a member of the Institution, should have presented a document so open to criticism. He speaks of 'nuggets' in a vein; that term, of course, being applied only to placer gold. He says a good deal about telluride minerals without making it clear how it affects the value of the mine. It is probable that molybdenite has been mistaken for tellurides, although petzite, altaite, and other base-metal tellurides do occur. The test for a telluride is so easy that no excuse exists for confusion. In any case, the information, as given, is conflicting. Apparently the ore—because of the molybdenite—is not docile to amalgamation, for the extraction ranges from 51 to 64% only. This is compared with the extraction in the Village Deep mill, given as 54·4%, to which 42% should be added for extraction by cyanidation. The description of the veins themselves is technically incorrect: Mr. Johnson talks about a "dip-strike," meaning probably the 'pitch;' and he says that "the strike in depth is greater than the length of the strike of the paychute [meaning 'ore-shoot'] on the surface." Strike should be expressed in terms of the compass; it is a measure of direction. He asserts that "there is every reason to expect the veins to continue in depth, the values at 200 ft. being better than on the surface." This is no reason, unless by 'depth' he means 300 feet. He does not discuss the one vital factor, namely, the relation of the veins to the porphyry, except in one obscure and inconclusive paragraph. Finally, as regards the known resources of the property, he finds a reserve of 31,000 tons valued at £220,000. But this estimate evidently did not please the 'management'—presumably the vendors—so he endorses the management's estimate of "over £400,000," explaining that he based his figures on the actual width disclosed in the workings, namely, 5 feet, "whereas the management no doubt takes credit for a width of about 10 ft., and it is only fair to say that recent cross-cuts point to at least such a width and probably more being proved, and systematic cross-cutting will, in my opinion, bear out the latter figure." Why, then, in the name of Agricola, does Mr. Johnson submit £220,000, or half of "over £400,000," as *his* estimate? He says he "cannot deviate from the accustomed practice of basing figures on the actual width disclosed by the drifts, etc., to date," but he assumes the average assay of ore in the shaft without having been able to see or sample it himself. He says that the ore 'blocked out' amounts to 12,000 tons averaging 26·9 dwt. "after neglecting the value of the cross-cut," but on the next page he assumes an average (34·5 dwt.) that includes the high assay from this very cross-cut. On the face of such contradictory statements his opinion of the ore available ceases to have any value in business. Indeed, the information forthcoming concerning the Tough Oakes and the Kirkland Lake Proprietary is altogether unsatisfactory, and as it comes through a Rhodesian financial agency it must be discounted severely. Some rich ore has been discovered, and healthy prospects exist, but the evidence does not warrant the iridescent expectations expressed by the promoters. As far as the geology is concerned, the veins traverse a schistose conglomerate cut by felspar porphyry, in the shape of dikes and intercalations.

On January 28 the prospectus of the Kirkland Lake Exploration was advertised. This is worse. The first company had at least secured an option on the richest mine in the district, but the second had only symptoms of indications of doing business. The chances are slight, for the best claims have already been optioned, and only wild-cats on the outside are likely to be available, or inflated schemes with the Kirkland Lake Proprietary, the shares of which are mentioned in the prospectus "as evidence of what is believed to be the value of this new gold-mining area"; as if such quotations afforded a measure of economic value. Nor does the personnel of the board encourage the expectation that "substantial profits should be earned." It is true one of them is Dr. F. H. Hatch, but he has no special knowledge of mining in Ontario, and the name of the company's resident engineer is withheld. Out of 150,000 shares, 100,000 are optioned to the Anglo-Spanish Trust, with which two of the directors, Colonel Charles H. Villiers and Mr. George Cornwallis West, are connected. These two gentlemen have also taken a call on 5000 and 20,000 shares, respectively. What is the consideration? Finally, why was Dr. Hatch given a call on 1500 shares? Was it because his name gave an air of technical verisimilitude to an oblique financial performance? It is true, owing to sundry protests, he has sur-rendered this call, becoming consulting engineer as well as director, but it remains a thousand pities that the President-elect of the Institution of Mining and Metallurgy should be involved in an affair of this kind. It is nothing more or less than the creation of a counter for unintelligent gambling, only remotely related to the mining with which Dr. Hatch has had an honourable connection. Such blind pools are not adapted to joint-stock finance; they should raise their capital privately and defer a public issue until they can furnish evidence that they have something to offer, besides the vague expectations of optimistic promoters.

Syndicalism in South Africa.

The sudden collapse of the general strike in South Africa is an event not only fortunate for the present, but significant for the future. If the effort to destroy the State, as an organized entity created and maintained for the protection of a civilized community, had succeeded, even to a minor extent, it would have entailed a recurrent menace to industry throughout the Union. For this escape from a great peril General Botha and his colleagues deserve not only the congratulations but the gratitude of all good citizens. The result was brought about by the hearty co-operation of Boer and Briton alike; indeed, the scotching of this anti-social evil was worth while if only to obliterate the old racial rivalry in a joint support of law and order under a common flag. It was a syndicalist plot, with the grievances of the railway workers as an excuse. The happenings of last July had left an impression that the Government was weak; the agitators at the head of the Federation of Trades Unions thought that a second trial of strength was opportune; they counted on dynamite to terrorize the community, and upon intimidation to 'pull out' those loath to cease work. But the arrest of the principal agitators confounded the unruly mob that is always ready for trouble, and the prompt proclamation of martial law put a wholesome fear into those who expected to stampede the better class of workmen. The strike collapsed, fortunately before it had seriously affected work at the mines, and long before it became necessary to consider the repatriation of the natives employed underground. An industrial revolution was frustrated. The syndicalist agitators are fittingly punished by deportation. On January 27 nine of them were placed on a steamer and shipped to England. On their arrival here, the whole question will come before Parliament. We forebear comment at this time, but we take the opportunity to express entire sympathy with the Government of the Union in its effort to solve a difficult problem by prompt action. To flourish a flaming torch on Salisbury Plain may be only foolish; to perform the same antics in a powder magazine, especially near black powder, is criminal. The Labour leaders flaunted the red flag before an audience of 200,000 natives. In South Africa the black population is to the white in the ratio of six to one. Those who flout civilization must not complain if they seem to receive barbarous treatment. We hope and expect that the action of General Botha will be sustained.

Successful Mining II.

Several dredging enterprises have come to fruition. For instance, the Renong Tin Dredging Company, which is successor to an unsuccessful syndicate of the same name operating in Siam. In 1908 Mr. E. T. McCarthy drilled the ground, and made a report; he found that it covered 140 acres of alluvium, 40 feet deep, averaging 12 ounces black tin per cubic yard. He recommended the syndicate to erect a dredge. The Consolidated Gold Fields which was a prominent member of the syndicate demurred to this, but subsequently on Mr. McCarthy expressing willingness to accept entire responsibility, it joined in the enterprise. In February 1910, the dredge began digging, under the modest burden of a capital of £30,000. By June 1913, the sum of £29,303 had been paid in dividends. In addition, £10,000 had been paid on account of two more dredges, and £9000 was in hand. Thus a profit of £48,000 had been made in the 2½ years from the commencement of operations. An additional lease of 320 acres was acquired during this period, and 100 acres that had been bored gave results similar to the ground already worked. An exclusive prospecting license for a further 1000 acres has been granted after two years of negotiation with the Government. At this juncture, in June 1913, the little company was re-organized, in order to raise further capital, and the present company was formed with a nominal capital of £125,000, of which 25,000 shares are 15% cumulative non-participating preference shares and 100,000 are ordinary shares of £1 each, of which 69,067 have been issued. The old company received 41,321 of the common shares and the whole of the preference shares for its property, plant, and cash. Since then the dredge has continued to do well, enabling the 15% preference dividend to be paid. One of the two new dredges is in course of erection. In this case the original estimate has been fully confirmed, if not better, for the 15% margin allowed on the drilling results has proved to be unnecessary, while the cost of operation has proved absolutely correct, thanks to the excellent management of Mr. Frank Nichols. During the last half of 1913 the output was 160·7 tons of black tin from 398,800 cubic yards of gravel, so that the yield was 14½ oz. or 14 pence per yard. It remains to add that the total cost is 7d. per yard, of which 3·1 pence is expended in actual dredging, 1·2d. goes for cleaning the concentrate, 1·7d. is deducted for export duty, and 1d. for agency and London expenses.

Another, even more remarkable, change of fortune is that of the Oroville Dredging Company. This was first registered in the United States, in 1905, to acquire dredging lands in the Oroville district of California. After four years the control was transferred to the present company, registered in June, 1909. The enterprise was a disappointment, largely because a big part of the property, namely, the Bear River claims, proved valueless. This was due to the time-worn blunder of taking a vendor's opinion. During the 8 years the operations had yielded 40% in dividends, or 5% per annum on an issued capital of £564,998. In 1908 a concession was acquired in the valley of the Nechi river in Colombia. This covered the Pato property, which became the basis, in October, 1909, for a subsidiary company, in which the Oroville holds 74,993 shares out of the 100,000 issued. This gold-dredging area was drilled and examined by Messrs. A. P. Rogers and C. H. Munro, who stated that 312 acres contained 13,000,000 cubic yards of gravel that would yield 34 cents per cubic yard. A 9-ft. bucket-dredge was erected and began work in December 1912, but did not reach the tested area until August 1913. In the five months, from August to December, inclusive, the yield has been $354,509 from 476,870 cubic yards, indicating an average return of 74 cents per yard or 2½ more than the engineers' estimate. The cost per yard at Pato was 11·82 cents from February to August, but it was 8·76 c. only during August, so that the official estimate of 10 cents is justified. Allowing 1 cent per yard for London and other expenses, the total cost may be taken at 11 c. per yard. Furthermore, a recent examination of an adjacent property, the San Francisco, covering 400 acres on the other side of the Nechi river, has led Mr. W. A. Prichard to advise the company to complete the purchase of it for $51,000. Mr. Prichard reports, after drilling, that he has tested 90 acres giving an average of 70 cents per cubic yard, for a depth of 48 feet, making a block of 6,900,000 cubic yards, from which £700,000 may be obtained, after deducting costs of operation and equipment. The directors have declared a 10% dividend, and feel justifiably gratified at the unexpectedly favourable turn in the fortunes of their enterprise. If the drilling of the San Francisco property is confirmed by the dredging, they will have made a magnificent deal. Meanwhile, the curious, but fortunate, discrepancy between the drilling and the dredging results on the Pato itself is a matter of keen technical interest, on which we hope to speak at a later date. For the present, the yield, like a good wine, needs no 'bush.'

We have already mentioned the Renong. The Tongkah Harbour Tin Dredging company is another venture in the Malay peninsula that is able to give an unusually good account of itself, a fact all the more remarkable seeing that some examining engineers reported unfavourably on the promoters' statements. The tests gave widely discrepant results; nevertheless, though the promoters' estimate of 2 lb. per cubic yard has proved to be far too high, the profits have been large and the dividends handsome. The company is controlled in Australia, and few, if any, shares are held here. During the three completed years the output of tin concentrate has been 1142, 1315, and 1339 tons, the yield per cubic yard being 1·15 lb., 0·98 lb., and 0·9 lb. Five dredges are already at work, and a sixth was ordered in August last. As shown in a plan given in our 'Company Reports,' the company has dredging rights over 5350 acres in the outer harbour. The cost, not including royalty and depreciation, was 4·5d. per cubic yard, or 4·9d. with these items included. The shareholders have received £167,463 as dividends on a capital of £150,000. The cost of the sixth dredge is to be provided out of revenue, and the debenture issue of £18,000 will be liquidated in the same way. The ground still to be dredged is estimated to contain 150,000,000 cubic yards. Though the yield per yard is slightly decreasing and will probably continue to do so as the dredges get farther from the shore, and though the present outlook for tin is none too rosy, the company will continue to make satisfactory profits. Moreover, it is not overweighted by extravagant expenditure or improvident finance. The earlier work in connection with the dredging was done by Mr. M. T. Nelmes Bluck, and he was succeeded last year by Mr. Eliot T. Lewis, an engineer with much experience of dredging in the East.

Last month we mentioned one Australian mine, the Mount Morgan; on the opposite side of the island continent is the Sons of Gwalia, at Leonora, in Western Australia. The company operating this mine was registered in 1898, and has had a prosperous career, paying a dividend every year since 1900. In 1912, 4s. 3d. was distributed, and in 1913 4s. per share, on 325,000 issued shares. Up to the end of 1913 this mine had yielded gold worth £3,758,462 from 1,869,764 tons of ore, or an average of 40s. 2d. per ton. Dividends amounting to £892,862 have been paid, so that the total cost has been 30s. 8d. per ton. Two years ago, however, some anxiety was felt as to the life of the mine, because the main orebody became patchy and poor below the 13th level, down to the 17th. On the 17th and 18th levels the main drift had been extended 1300 feet south without finding any ore, and prospects were gloomy. The drifts were continued so as to tap the southern orebodies, of which there are several, overlapping each other. Meanwhile, a cross-cut was started at about the middle of the 17th level to exhaust any possibility of finding ore outside the main vein. Good ore was cut 40 feet east of the level. Thereupon systematic diamond-drilling on the 18th level, and also on the 19th, proved that a large orebody had been missed, for the drill-holes disclosed a fine lode flanking the poor vein previously followed. The result up to date is that on the 19th level (which is at a vertical depth of 1815 feet) a run of ore over 1000 feet long, averaging 8 feet wide, has been proved; and the full extent of it has yet to be determined. Furthermore, a winze, now 110 feet deep, is going down in 25 dwt. ore. It should be added that the ore opened up on the 19th level is quite up to the average grade of the output during the last three years. The new orebody has been traced up to the 15th level, and it remains to be shown whether it unites with the main ore-shoot as stoped in the upper workings. In any case, the development during 1913 will prolong the productive life of the mine for many years.

Future of the Rand.

The mayor of Johannesburg stated, at the annual dinner of the Chemical, Mining, and Metallurgical Society, that when the 5½ million municipal loan was floated in 1904, the life of the gold mining industry of the Rand was assessed, for loan purposes, at 30 years. This would leave 20 years from the present time. We note also that the Chamber of Mines has recently informed the Economic Commission that it estimates the maintenance of the present rate of crushing—28,000,000 tons per annum—for five years more, and a decrease to one half the present tonnage by the year 1931, or 17 years hence. It may be interesting to recall the several authoritative estimates that have been made previously:

	Date.	Estimate.
J. Hays Hammond	1901	1926
F. H. Hatch and T. H. Leggett	1902	1944
Loan estimate	1904	1934
F. H. Hatch	1911	[1950]
G. A. Troye	1913	1940
Chamber of Mines	1913	[1940]

The first of these forecasts evidently erred on the side of conservatism, but in the light of later evidence, it was also invalidated by sundry false assumptions, such as the idea of uniform persistence of ore in depth, and an estimated diminution of only 6s. per ton from the working cost as it was under Boer regime. The orebodies do not maintain their richness to the depths postulated; while, on the other hand, the working cost has been decreased by over 8s. per ton since the war. The cost is ascertained by deducting the total dividends from the total yield. The estimate made for the financiers who made the loan in 1905 was admittedly conservative, and, for such a purpose, was correct, as far as can now be judged. The estimates of Messrs. Hatch, Leggett, and Troye are so nearly in agreement that they may be considered the same. Mr. Leggett declined to assert that mining would be continued to a vertical depth of 6000 feet; on the other hand he demurred to Mr. Hammond's estimated saving of 6s. per ton, because he himself was prejudiced against the British administration of the Transvaal. The later estimate of Dr. Hatch assumes that an average output of £30,000,000 per annum can be maintained for 35 years, "that is, down to a vertical depth of 6000 feet," but he hints that the banket will be profitable "at still greater depths," so that a fair interpretation of his guarded forecast is that the life of the industry will be prolonged to 1950, at least. Mr. Troye's estimate appeared in our issue of July last. We regard it as having been made by an independent engineer both well informed and detached from the share-market. We consider it to be the most reliable now available, and in this belief we are confirmed by the statement made last month by the Transvaal Chamber of Mines. That statement did not give 1940 as the date of exhaustion, but it was, in our opinion, equivalent. Finally it remains to add that in 1911 Mr. H. C. Hull, when Minister of Finance, estimated the future production of the Rand at £2,000,000,000, which is equivalent to 50 or 60 years at the present rate of production. He ought to have been well informed, but probably he was not. And to this optimistic forecast we may attach that of Mr. W. R. Boustred, the former mayor of Johannesburg, who, a few months ago, declared that "the reefs of the Witwatersrand will still be unexhausted seventy and eighty years hence." That is quite likely, for it will prove inadvisable to "exhaust" them whenever they cease to yield a margin of profit. This brings us finally to the statement made in 1906 by a committee of representative mining engineers that "unless in the near future working costs can be brought down to 16s. for the producing mines, the profitable life of the Rand will be comparatively short, and the foundations of the structure of State and Municipal finance, which have been erected on the output of the Witwatersrand, will crumble." The meaning of this depends entirely upon the significance of the word 'comparatively.'

Like most of the other estimates, moreover, this one has to be discounted. It was made when bringing pressure upon the Government with a view to obtaining a decrease of railway rates. The recent Chamber of Mines' estimate, similarly, must be discounted a little, as being a hint to the Government that it had better take care to preserve the goose that lays the golden eggs. The loan estimate is comparable to the valuation of property for mortgage purposes. On the other hand, the optimistic Minister of Finance was looking at the mining industry of the Rand from the standpoint of possible taxation, and the Mayor was trying to cheer the owners of property in Johannesburg after sundry depressing events. On the other hand, the four engineers above quoted were all endeavouring to correct exaggerated notions that had appeared variously in the public Press; they also were, so to speak, sounding a warning note. Obviously, the life of the industry depends on the total cost of mining, for the tonnage of poor ore is incalculably larger than that of a grade hitherto found profitable. The so-called working cost is given officially at an average of 18s. per ton, but this is a fictitious figure; for the actual total cost is obtained by subtracting dividends from yield, according to which the real cost in 1913 was 21s. per ton. In 1907 Mr. Ross E. Browne said that "under the most favourable conditions it is plainly possible to lower the cost to 14s. per ton without materially reducing the high average white wage now prevailing." By 'cost' he meant 'working cost,' so that his 14s. was equivalent to a real cost of 16½ shillings. We agree that a reduction to that figure is possible within a decade, by reason of less reckless expenditure in equipment, by the more intensive use of mechanical appliances, and by training the natives to become skilled workers. Now that the false idea of uniformity of gold distribution and unbroken persistence of ore has been shattered, it is likely that exploratory work will become more intelligent, and more successful. The pitch of some of the big orebodies may prove to extend under areas now considered barren, and in one or two instances, where the dip is exceptionally flat, the ore may persist, if not to a vertical depth in excess of present indications, yet for a distance on the lode equivalent to greatly increased continuity. We see many reasons for doubting forecasts of a definite extinction of the great mining industry of the Witwatersrand, but we see none for doubting an accelerating decrease in the net resultant profit to be derived from the mining operations. The so-called selective method of stoping, made prominent during the last three years, simply means an abandonment of the effort to make low-cost records at the expense of ultimate profit, but it also entails an abbreviation of the lives of many mines as based on non-selective stoping. You cannot eat your cake and have it. To discard the unprofitable banket that previously swelled the tonnage is equivalent to diminishing the gross tonnage of real ore available for the mill; it involves the shortening of the life of the mine as measured in terms of selected ore, that is, ore free from excessive waste. But long after the ore of current grade has been exhausted the mines will produce a big tonnage yielding a diminishing profit; that profit although small, as a return on the capital involved, will enable the mines to continue as going concerns, employing engineers and workmen, consuming supplies and machinery, and paying taxes at Pretoria and London. A great mining district dies hard; look at Leadville or Cripple Creek, Bendigo or Broken Hill, El Oro or Pachuca. The funeral of the Witwatersrand is not likely to be attended by any of its present appraisers.

Russo-Asiatic.

Reading the account of this company's meeting on January 14, we are much impressed with the business-like character of the statement made by the chairman, Mr. C. J. Cater Scott. Indeed, the whole tone of the proceedings was marked by a sanity and good sense in refreshing contrast to the ordinary *opera bouffe* performance called a company meeting. The chairman stated his facts lucidly, his technical references were correct, and his judicious mingling of reasonable optimism and timely caution was not only in admirable taste, but in the highest degree convincing as an expression of sagacious administration. After one of the shareholders had made some amateurish references to technical matters, it fell to Mr. R. Gilman Brown, as a technical director, to make further comment, which was done in exemplary fashion. Indeed, Messrs. Cater Scott, Leslie Urquhart, and Gilman Brown, as directors, have treated their shareholders in meeting assembled with a frank courtesy that we cannot commend too highly, for, while it is not unique, it is decidedly rare. For that reason, if for no other, we hope the Russo-Asiatic Corporation will be completely successful. We believe it will. Apart from wise control in the board-room, we can tell the shareholders that their affairs are going forward under technical guidance of the highest character. To us, of course, the names of R. Gilman Brown, Deane P. Mitchell, and T. J. Jones are as familiar as their professional records. The combination of experience connoted is an assurance against any unnecessary error. It is human to err; it is the aim of engineering to reduce the probability of error to a minimum.

In our last issue we spoke of the Anglo-American control of this company. This was not quite correct. We are informed that the shares are held largely in Russia, and that the American interest is meagre. The control, therefore, is Anglo-Russian; and while it is commonly identified with Messrs. Leslie Urquhart and H. C. Hoover, on account of their prominence in Russian enterprises, it is only fair to the chairman and the rest of the board to say that the administration is in the hands of the directors as a whole. More important is the fact that the capital of the company has not been watered, so that out of a paid-up capital of £300,000, no less than £285,000 remains on deposit, the interest therefrom being sufficient to pay all the London expenses of the company and a large part of those incurred in scouting for desirable properties. Of the original capital, £100,000 was furnished by two Russian banks, and £200,000 was subscribed by the Anglo-Siberian Company, out of the profit it had made on the Kyshtim issue. Since Russo-Asiatic became prominent some shares have been bought by the Russian banks, but, after the warning given by the chairman at the meeting, the dealings of punters and gamblers on the outskirts of the Stock Exchange have been negligible. It is also a curious, and highly satisfactory, fact that not a share was bought or sold by any director or official of the company until after the meeting. Since then the buying has been of a sanely speculative kind, to hold against the favourable development of the mines. It is obvious, therefore, that this company is being conducted on lines unusual to joint-stock finance, and we hope, therefore, that it may prove abundantly successful.

Plymouth Consolidated.

The prospectus of a company to operate this old mine in the foot-hills of California was issued on January 26. As recorded in this Magazine, the workings were re-opened by Bewick, Moreing & Co. under the immediate direction of Mr. W. J. Loring, one of the partners in that firm. The first examination was made by him, accompanied by Mr. Malcolm Maclaren, in September 1911. A favourable report having been submitted, the unwatering of the mine, the repairing of the shaft, and the clearing of old workings was completed to the bottom level, at 1600 ft. vertically, in October 1912. Since then a winze has been sunk to 2000 feet, and fresh ore has been uncovered on the 1850 and 2000-ft. levels, enough to warrant the erection of a mill and the commencement of systematic exploitation.

The Plymouth is one of a series of mines along the so-called Mother Lode, a lode-channel within a belt of schist running parallel with the main axis of the Sierra Nevada and along its western flank. Gold is found in bodies of quartz conforming to the strike of the enclosing schist, but dipping at varying angles across it. Mining on this lode has been variously profitable over a belt stretching from Mariposa county to Alpine county, a distance of 100 miles, but the central and most famous portion of this region is that within the boundaries of Calaveras and Amador counties. At the present time seven mines more than 2000 feet deep are in active operation, one of them, the Kennedy, having reached a depth of 3850 feet vertically below the surface. These facts, of course, encouraged the idea that the Plymouth, only 1600 feet deep, might come into ore again. It was presumed that the mine had been shut-down on account of impoverishment, but other reasons are now known to have existed. In 1888 a fire in the stopes occurred at a time when the yield was declining. Soon after the fire was extinguished, the controlling owner, Alvinza Hayward, gave orders to stop work. At that time the bottom levels were looking poor ; but a winze had been sunk 75 feet below the 1600-ft. level, and, as recently disclosed, had cut 2½ feet of $17 ore. Between the 950 and 1140-ft. levels in the southern ground another orebody had been exposed, and partly stoped in ore 3½ feet wide, assaying about $19 per ton. Therefore, the mine was not exhausted. The ultimate reasons for closing-down were legal, not economic. The Plymouth property was an agricultural patent giving the owners no extra-lateral rights ; the dip of the main orebody was bringing it under the Plymouth Gold Quartz claims, while the southern orebody had a dip that would cause it to apex in the foot-wall country covered by the New London claims. Hence the future expansion of operations underground was doubly threatened. These dangers have been obviated by the purchase of the conflicting rights and the consolidation of a large area, equal to 160 acres, affording ample security against trespass or litigation.

Mr. Loring considers 110,000 tons of ore to be proved, but on two sides only, as the ground between the 1850 and 2000-ft. levels has not been sectioned by rises or winzes. The tonnage available has a gross value of £150,667, equivalent to £72,858 net. It has been deemed inadvisable to open-up more stoping ground because the schist is heavy and extensive development would entail unnecessary expense in timbering and filling. Otherwise, it may well be asked why more ore has not been proved, having regard to a purchase price of £204,482 payable to the California Exploration Company, the present vendors. The working capital, to pay for the mill and other equipment, is only £33,000. The company is capitalized for 240,000 shares of £1 each, of which 127,000 are absorbed by the vendors, and 113,000 shares have been offered to the public at par under a guarantee that sundry Australian companies will take 50,000 of them. Anybody paying £1 per share is assured 6s. 8d. from ore already developed, and will pay 13s. 4d. on a gamble that the orebody will persist for several hundred feet in depth. Mr. Loring, and others thoroughly conversant with lode mining in California, believe that it is reasonably safe to assume such persistence on the basis of the record of neighbouring mines, and the excellent ore uncovered in the deepest of the Plymouth workings. We only hope it. The mine is not young, nor is it shallow; in order to justify a present valuation of £240,000 it will have to yield about 250,000 ounces of gold in the next 10 years. It is fair to add that all the essential facts are clearly stated in the prospectus, and if the issue is absorbed by the Australian companies that have financed the California Exploration Company, then the general public will not suffer, except in so far as influential people have set an example that it is inadvisable to follow.

Technical Spelling.

In Bulletin No. 112 of the Institution and in the December 27 issue of the *Mining and Scientific Press* we note in each case two inconsistent spellings of 'pyrite.' In the one case the editor, or editors, or proof-reader, has sanctioned the use of 'pyrite' in a quotation although 'pyrites' appears in the remainder of the text; while in the second case 'pyrites' is employed contrary to the normal style of the *Mining and Scientific Press*, which uses the form 'pyrite.' In the first case the idea evidently is that, when quoting, the *ipsissima verba* must be given even to the point of reproducing the spelling. This is not in accord with accepted usage. Unless the spelling has some peculiar significance it is customary to make the quotation conform to the style of the paper in which it appears. When *The Times* quotes a statement from a New York paper it reproduces 'rumor' as 'rumour' and 'today' as 'to-day.' On January 15 *The Times* published a letter from a representative of the Simplified Spelling Society, but the phonetic spelling associated therewith was not in evidence in the text. Of course, not. The point is that quotations have to submit to the spellings normal to the publication in which they are reproduced. As regards 'pyrites' in the San Francisco paper, we know that this spelling is one that was retained at the request of the learned writer of the article in question. We note that 'drive' has been condoned in the writings of a South African geologist, despite the fact that 'drift' is the spelling adopted by the *Mining and Scientific Press*. We mention this matter because sundry technical writers seem to be unaware of the fact that it is the rule for contributors to comply with the style-sheet of the publication to which they are contributing. If a Briton writes to the New York *Times* his letter is spelled in accordance with the usage of that particular newspaper; and if an American contributes to *The Times* he must conform to the style of London's chief newspaper. Obviously, if the editor, in an excess of courtesy consequent upon the polite insistence of his contributor, agrees to waive the custom of his paper in one case, he must do it in other cases; and thus uniformity of typography is at an end. Geologists and mining engineers should not insist upon their typographical idiosyncrasies. On matters of this kind they are not authoritative. The editor is. When they accept the hospitality of an editor's columns their writing must wear the garments conventional to the occasion.

Leaving the point of etiquette, we pass to a discussion of 'pyrite' and 'pyrites,' 'dike' and 'dyke,' 'drive' and 'drift,' all of which have been subject to recent vagaries of typography. 'Pyrites' is an obsolescent term, of which 'pyrite' is the modern form. The change to 'pyrite' was made for the sake of uniformity of nomenclature; in the same way 'barytes' became 'barite,' and pyrrhotite was preferred to 'pyrrhotine,' cassiterite to 'tin-stone,' 'sphalerite' to 'blende.' Pyrite is not peculiarly American; it is only modern. So finished a British writer as Mr. James Geikie uses the term, in preference to pyrites. Pyrites, of course, is not a plural form, but a pure Greek word πυριτης, meaning belonging to fire or fire-bearing, just as barytes or βαρυτης means weight. Pyrites is still retained as a trade term to designate the crude iron sulphide shipped in bulk for the manufacture of sulphuric acid, just as barytes is the term applied to the mineral product employed to adulterate paint, while barite is used exclusively for the sulphate of barium in mineralogy and geology. 'Dike' is reserved for the wall-like bodies of igneous rock, and 'dyke' for the earthen embankments constructed to restrict the movement of water. Those who recognize these distinctions have enriched their vocabulary by having two words in the place of one, thereby giving them an added precision of speech, such as is particularly desirable in scientific writing. 'Drive' is British and Australian; 'Drift' is old English and American; but not entirely, for in 'drift mining,' meaning alluvial mining by means of an underground passage, this term is honoured on both sides of the Atlantic. Both words come from the Anglo-Saxon *drifan*, and neither can be said to be wrong, but 'drive' is over-burdened with other significations, while 'drift,' as we have said, is firmly established in alluvial mining, at least. The miner drives forward, and the result is a drift. In Scott's 'Peveril of the Peak,' the lead miners are hailed as "subterranean badgers" and "drift-drivers." The three leading mining papers among English-speaking people have adopted 'drift' as the noun and 'drive' as the verb; this usage is, therefore, firmly established. The fact that 'drive' is generally used in South Africa, for example, is no argument, because a provincialism has no claim on those who try to write literary English. For guidance in mining or metallurgical practice we go to our comrades in the mine and mill, but we do not ask them to guide us in the use of the English language, save in its most objurgatory phase. No, the forms of English as a means of precise expression are settled by those who most use that medium of thought, namely, the newspapers. In technical writing, the lead must be taken by the technical papers, to whom the proper employment of terms is not a rare or occasional exercise, but a daily and constant duty. Technical societies can co-operate. To this end we venture to suggest that the standardization committee of the Institution should take action in the matter. In the last bulletin, for example, not only were 'pyrite' and 'pyrites,' 'beresite' and 'berezite,' 'payable' and 'profitable' used in the same paper, but even in the quotation 'dyke' and 'oxidised' were given instead of the 'dike' and 'oxidized' appearing in the original, so as to invalidate the use of 'pyrite.' These details may seem trivial, but one who has given diligent study to such matters can testify that they are the unconsidered trifles on which depends the final effectiveness of technical writing.

Secondary Enrichment II.

In a preceding issue we discussed sulphide enrichment, as exemplified by copper deposits. It remains to consider the equally interesting and more obscure processes that affect the distribution of gold in quartz veins. Undoubtedly the rich outcrops of such veins and the romance of their discovery constitutes a salient feature of mineral exploration. Hardly less spectacular has been the finding below the surface, sometimes many hundred feet from daylight, of 'pockets,' 'lenses,' and 'bonanzas' that have gilded the records of mining adventure. Some of the chemical and structural conditions favouring such orebodies have been recognized, thereby affording a clue to further search. Let us consider a simple case: that of a quartz vein containing gold in association with iron pyrite and other sulphides. At the outset it is necessary to distinguish two methods of enrichment, namely, the relative enrichment due to natural concentration, by elimination of the less valuable constituents of the ore, and the positive enrichment due to precipitation of additional gold through secondary reactions. When exposed at surface the quartz vein undergoes a process of disintegration analogous to the weathering of rocks. The rain penetrates the cracks and crannies of the rock; the variation of temperature, daily and seasonal, causes such intrusive water to expand and contract; above all, the sudden expansion of water, at the moment of solidification into ice, gives it the power of a steel wedge, rending and shattering the rock, and exposing it to further attack from the elements. The outcrop of a vein is continually subject to such attack. When shattered, it is subject to removal by wind and water, with the gold, forming placer deposits. At the same time, the oxygen in the air and the oxygen carried by the water corrodes the substance of the lode. The pyrite is oxidized and hydrated. By oxidation it becomes a soluble sulphate and is washed away; by hydration it becomes a hydroxide, part of which remains as limonite, reddening the quartz, now honeycombed by removal of the crystals of pyrite, leaving cubical casts in which lingers gold and sometimes sulphur. Iron sulphide in the presence of oxygenated water yields ferrous sulphate and sulphuric acid. By intermediate reactions both sulphur dioxide and sulphur itself are formed. Thus yellow particles of native sulphur have been detected in the cast of pyrite crystals. The ferrous sulphate changes readily to ferric sulphate, which is a strong oxidizing agent and able to attack unaltered pyrite with avidity. Thus more pyrite is decomposed. At the same time, the other base-metal sulphides, such as those of copper, lead, and zinc, succumb to oxidation and to the sulphuric acid generated from pyrite; similarly non-metallic ingredients, such as felspar, gypsum, or mica, associated with the quartz of the vein, are decomposed or dissolved. The intense disintegration, mechanical and chemical, due to weathering, ends in the dispersal of the less durable constituents of the quartz vein, leaving a honeycombed iron-stained wreck, called the 'gossan,' in which the gold, by reason of its higher specific gravity and lesser solubility, survives, and in a condition relatively concentrated, for the volume of its containing matrix has undergone contraction, by removal of some of the quartz, all of the soluble gangue, and most of the metallic sulphides. During this process the erosion of the surface and the removal of the uppermost portion of the vein has depressed the outcrop, enriched it by concentration of the gold, and caused residual chemical solutions to penetrate downward. Oxidation usually extends to the water-level, but some of the effects of oxygenated water extend much deeper. The 'water-level' of the miner is the top of the water-zone, a region several hundred feet in vertical extent, in which every cavity in the country-rock is full of free water. The vertical depth at which this accumulation of ground-water is reached will depend upon rainfall, temperature, and structural conditions. Normally water is struck at 100 feet or less; in arid regions the top of the water-zone may be more than 1000 feet below the surface. It coincides usually, but not always, with the vertical limit of oxidation. As oxidation in a lode is the effect of oxygenated water, it follows that fissuring and other structural factors favourable to the downward penetration of water will also facilitate the spread of oxidation and those reactions arising therefrom, as is shown remarkably in the Butte district, where successive periods of faulting have provided unusual conduits for descending solutions. In glaciated regions the outcrops have been razed, and there the zone of oxidation may be entirely lacking, so that primary vein-matter appears at daylight. In warm climates oxidation reaches deeply because the higher temperature favours chemical action. The details of such action in nature are only surmised; the limitations of time and dilution in a laboratory experiment are so unlike the vast duration and extreme complexity of chemical interplay during periods of geologic duration as to permit only a faltering guess on the part of the most recondite of savants. However, the rudiments of the chemistry involved have been elucidated. At surface and near it the principal reagent is oxygen in water; in addition, carbon dioxide and sulphuric acid are present in varying degree. The sulphates thus produced sink into the lode until they react with unaltered sulphides, forming secondary sulphides. The gold is liberated from its close association with pyrite, some of it remaining in place, while the rest of it is dissolved in the descending water, which, subsequently, at the water-level or near it, deposits the gold, forming an enrichment of the lode. Concerning the precipitants of gold from solution we do not argue, for they are plentiful; as to the solvents, we still dispute. Formerly it was held that ferric sulphate, readily formed from ferrous sulphate, was a suitable reagent for solution. When pyrite is decomposed by oxidation it yields first the ferrous sulphate, which is a reducing agent, and then the ferric sulphate, which is a strong oxidizer. Whether ferric sulphate dissolves gold is open to question. Indeed, the only unquestionable natural solvent is chlorine in a nascent state, when liberated from a chloride, such as common salt, sodium chloride, in the presence of sulphuric acid and manganese dioxide. All of these substances are found in lodes. Hydrochloric acid is not uncommon in mine waters, and the black oxide of manganese is found in many oxidized ores. A reaction between them will liberate chlorine, which will attack gold readily, forming a soluble chloride. In metallurgy, chlorine is used for this purpose, just as ferrous sulphate is employed to precipitate the gold subsequently. Thus the gold starts on its pilgrimage along the conduits that permit the descending oxygenated water to penetrate deeply. On the way precipitants are waiting to arrest it. Carbonaceous matter in the wall-rock of the vein, and vegetal remains, such as the roots of trees, which may reach 100 feet below the surface of the ground, may be mentioned, in addition to ferrous sulphate, pyrite, and other sulphides. Thus the normal gold content in the primary ore is increased by addition from the solution descending through the zone of oxidation. Cubes of pyrite with minute crystals of gold on their facets have been found in veins, thus affording testimony that is suggestive even if not conclusive. Where cross-fissuring is observed near the water-level it is not uncommon to find 'pockets' of native gold in a quartz vein. There unlike solutions have mingled, and there a maximum volume of descending solution may be supposed to have reached a place where de-oxidation was active, including intensive precipitation of the gold. Other conditions apparently favourable to secondary enrichment have been observed and described. But positive assertions on the subject are rarely warranted, for we who observe a deposit of golden ore are only witnesses to a transitory condition. The words 'primary' and 'secondary' are used for convenience. Nothing 'primary' or 'secondary' can be asserted to exist; all is transitory. We get a glimpse of a long series of changes and surmise therefrom those that were precedent. An ore deposit represents the gain of convergence over dispersion; the enrichment that constitutes a bonanza is the triumph of concentration amid that flux of chemical change we call nature.

SPECIAL·CORRESPONDENCE

LIMA.

Copper production in Peru for 1913 has been at about the same level as during the previous year. It was at one time expected that the Cerro de Pasco would provide a substantial increase, but the actual figures for the production at this mine were only 45,000,000 lb. On the other hand, the Backus & Johnston company has increased its output to well over 10,000,000 lb., and smaller producers have done more mining, being encouraged by the better price for copper. The production for the year may be estimated at 30,000 metric tons, as compared with 27,400 tons in 1912. The Cerro de Pasco hydro-electric plant will have two out of three units in operation early in January; it is expected that the maximum power of the operating units, 4000 h.p. each, will be connected at the mines and smelter by the close of the month. The line to Morococha will probably be in service by April. The elimination of coal for power purposes and the increasing output from the Quishuarcancha coal mines, all reduce the possibilities of a shortage of locally made coke, and thereby permit more ore to be smelted as well as reduce the smelting cost. Three Dwight-Lloyd sinterers are in use and four more are to be installed; their capacity varies from 45 to 80 tons per 24 hours, according to a low or high sulphur content in the ore. The monthly tonnage of ore smelted has been as high as 35,000 tons, attained with the plant not running full capacity.

The converter plant and new 160 by 52 inch furnace of the Backus & Johnston Co. were blown-in during the latter part of December, with satisfactory results, and the old furnace was put out of commission for necessary repairs. The year 1914 will therefore commence with shipments of blister copper and increased production. The company has commenced to retire part of the £100,000 bond issue made early in 1913; £2000 of bonds were paid off on December 31. The new hydro-electric plant is not working at full capacity, as the line to the Morococha property of the company is not expected to be ready until March. During the early part of December a general strike was threatened in Morococha, through the demand for a 100% increase of wages, inspired by several outside agitators. The Backus & Johnston Co. refused to hear the claims of the strikers as a body, but was willing to regulate individual complaints. Only one day's work was lost, and labour matters are undoubtedly in better shape that heretofore. Troops were sent from Lima, but no violence was attempted as the sale of liquors was prohibited. Work at Ferrobamba continues at a standstill. The Cuerpo de Ingenieros has had a commission investigating the region; the report will be out in February.

Gold.—The Sociedad Aurifera Andaray Posco Ltd., operating in the province of Condesuyos, has been obtaining better results. The monthly production now varies between £500 and £800 in gold bullion, recovered from 20 tons of ore treated per day. The new cyanide plant, sent from the United States, is expected to arrive in January; it was ordered as the outcome of the tests which indicated an extraction of 90%. The New Chuquitambo Gold Mines Ltd. produced 360 oz. in November. At Cochasayhuas, the Cotabambas Auraria is now producing at the rate of £3000 of bullion per month with the cyanide plant in running order. Concentration on two Ferraris tables is effected after amalgamation, and the tailing, free from from slime, is cyanided. More active exploration of the veins and extensive improvements in the plant are contemplated. The gold placers taken up by a New York syndicate were incorrectly stated (in the November issue) to be on the Huallaga river. The ground referred to, 20 miles long, is situated near the headwaters of the southern branch of the Marañon river, in the department of Huanuco, 4 days horseback ride from Cerro de Pasco. The Peruvian Exploration Company, as the syndicate is called, has raised $300,000 for operations. It is anticipated that washing will begin in March 1915. Dredging has not been considered feasible due to the difficulties of transportation for machines capable of proper efficiency, hence the employment of giants for the gold winning; these latter will handle 25,000 cu. yd. per day, and their number will be increased until 100,000 cu. yd. is washed per day. The river is said to have an average width of 100 ft. and a depth of 3·5 ft. in the dry season, with a normal flow of 4 miles per hour, equivalent to approximately 2000 second-feet. It will be diverted, in sections, to a canal, 20 ft. wide and 15 ft. deep, which will have to be made. The gravel is said to average $0·809 equal to 3s. 4·5d. per cu. yd.; the gold has been described as coarse and much of it angular. It is stated that there is 131,150,840 cu. yd. available in the 1117 acres controlled. The gravel is 73 ft. deep, on an average, and bedrock was not reached in the greater number of test-pits due to the influx of water from the river. The gross value may be calculated at $106,106,482, or £22,116,000, but it is claimed that the actual value is $500,000,000 or £100,000,000, allowing for "the coarse nugget gold and probable concentration over the bedrock."

The Oil Industry has been making strides, and the output for 1913 will probably be over 2,000,000 barrels, as compared with 1,750,000 bbl. in 1912. The annual report of the Lagunitas Oil company, which is operating on ground leased from the former London & Pacific Petroleum Co. now controlled by the Standard Oil, shows a gross profit of £22,355 for the year ended June 1913 and a net profit of £1059. The monthly output has been gradually increasing and is now over 3000 tons; steps are being taken to acquire additional ground, La Brea of 2560 acres, so as to furnish the basis for a larger business, as 30,000 tons per annum must be delivered to the lessors. The opening of the Panama Canal and the increasing demand for Peruvian petroleum, with its high benzine content, are sufficient stimulus for the proposed activity; a refining plant may be erected near Panama. There has been considerable local discussion to increase the Government revenue from oil lands, as that received from the yearly mine-taxes is an insignificant amount. A tax of 50 centavos, equal to one shilling, per ton has been proposed, but such could not have effect until November 1915, in view of the existing decree prohibiting any duty on the minerals, metallic and non-metallic, produced prior to that time.

Tin.—Inquiry made to confirm the statement that the "surveys of tin deposits recently discovered near Canta, in the department of Lima, and at Huaranchal, in the department of Libertad, are reported to be progressing rapidly and giving excellent results" has met with negative results. The 'tin' ore from Canta appears to be a bismuth mineral; near Huaranchal a little stannite is found with copper-silver minerals, but its occurrence is of no economic importance. The Cuerpo de Ingenieros has neither received samples nor been advised of this discovery.

TORONTO.

Cobalt had a prosperous year, the dividends paid in 1913 establishing a record. The total amounted to $10,271,694, as compared with $9,324,044 in 1912, the total estimated production of silver being 30,600,000 oz. The dividends paid since the outset amount to $46,933,818, exclusive of the profits of close corporations, which would bring the total to about $51,638,000. Of the shipments last year 9,326,563 oz. was in the form of bullion valued at $5,471,978, while the consignments of ore amounted to 21,173 tons, being a slight reduction from the ore shipments in 1912. The dividend-paying mines number 17, the Seneca-Superior, Cobalt Lake, and Caribou-Cobalt appearing for the first time on the list. The latter, however, is an old producer, formerly known as the Drummond. Recent shipments indicate that the output of Cobalt is finding a wider market, the Nipissing having sent 200,000 lb. of ore to Birmingham and Manchester, while the Crown Reserve and Dominion Reduction companies have forwarded consignments to Hamburg. There is also an increasing demand for ores of high cobalt content. The Nipissing has increased its ore reserve by exploratory work on Lot R.L.400, north of the present workings. Three new veins were discovered in a cross-cut on the fourth level of shaft 73, all of them from 1 to 1½ in. wide, carrying ore running from 1000 to 2500 oz. per ton. During December the Nipissing mined ore of an estimated net value of $164,794, and shipped bullion to the value of about $400,000. The total production of the La Rose for 1913 was 2,634,000 oz., having a gross value of $1,550,000. The net profit for the year is about $953,000, as compared with $1,022,691 in 1912, and the surplus on December 31 amounted to $1,864,434. The annual report of the Coniagas for the year ending October 31 showed a total revenue of $2,186,664; working expenses were $484,445, making the working profit $1,702,219. The total silver shipments in ore and concentrate amounted to 3,572,398 oz. The total cost of production was slightly over 13 c. per ounce of silver. The ore reserve is estimated to contain 13,329,000 oz., this being a reduction of about 600,000 oz. during the year. The regular quarterly dividend has been declared of 6% with an additional bonus of 3%, making dividend and bonus amounting to 12½%, which will bring the amount returned to shareholders within a year up to 90% of the capital. The Aladdin-Cobalt of London, which is working the Silver Queen mine on a lease, has discovered an ore-shoot 6 in. wide and 30 ft. long on the second level. This must have been

the total returns to shareholders since the start $6,080,000. The draining of Cobalt lake by the Cobalt Lake Co. has been authorized by the Mining Commissioner, T. E. Godson, and the preliminary work of clearing out the creek, which forms the natural outlet of the lake, has been begun. It is expected that the work will be completed by October next. The Seneca-Superior has declared a overlooked during former operations. The Aladdin, which has now a controlling interest in the Chambers-Ferland, has offered to buy out the shareholders in the latter company by giving them one share of Aladdin of the par value of $5 for every 20 shares of their stock. The Casey-Cobalt has had a prosperous year. The installation of electrical equipment has increased the capacity of the mill from 30 to

80 tons per day, and the silver shipments have increased from 274,066 oz. in 1912 to 607,621 last year. The annual report of the Cobalt-Townsite showed that during the 11 months ending with September the net earnings of the company were $629,622, as against $512,081 for the preceding 12 months. The ore reserve shows an increase, notwithstanding a production of 1,987,921 oz. silver. After paying dividends amounting to $375,000, a balance of $458,988 was carried forward.

Elk Lake and Gowganda.—There is a decided revival of activity in these districts, which are badly handicapped by lack of transport facilities. The Larry Downey claim between Elk lake and Silver lake has shipped half a carload of high-grade taken by hand out of an open-cut, the value being estimated at $20,000. Machinery will be installed and development pushed. At the Fleur-de-lis a shaft is down to 250 ft. High-grade ore has been found above the 100-ft. level. At Gowganda the Miller Lake-O'Brien has a large force employed, and is producing at the rate of about 60,000 oz. per month. The Mann is sinking to the 200-ft. level, and has shipped 20 tons of high-grade ore to the smelter. An English syndicate is reported to be negotiating for the Mann and other Gowganda properties.

Porcupine.—During 1913 the Dome milled 131,059 tons of ore producing gold of the value of $1,239,503. The returns for December showed a slight decrease from the previous month, the production being $106,904, as compared with $121,150. The yield for the year was $9·50 per ton, which illustrates the conservatism of the estimate given by Mr. W. W. Mein last March, when he estimated the proved tonnage above the 45-ft. level at an average of $7·53 per ton. The Hollinger paid $1,080,000 in dividends during 1913. The regular 4-weekly statement for the period ending December 2 showed a profit of $118,090 from 12,757 tons of ore, assaying $15·17 per ton, with an approximate extraction of 96·16%. The entire cost per ton milled was $5·18. By diamond-drilling an important extension of No. 1. vein on the 200-ft. level has been picked up. No. 5 vein when reached by a cross-cut on the 200-ft. level showed a width of 22ft. carrying $12·27 per ton. The winze from the 425-ft. level on No 4 vein has reached a vertical depth of 550 ft., where a station will be cut. The directors, after a visit to the mine, have decided to start diamond-drilling to a depth of 3000 ft., and plans for a considerable enlargement of the plant are under consideration. Preparations are being made for active operations at the Dome Lake, in which the Temiskaming & Hudson Bay company has obtained a controlling interest. The shaft is to be put down to 400 ft., and a cross-cut run on the 180-ft. level to pick up No 1 vein. An electric equipment will be installed. The shareholders have been asked to ratify an increase of the capital from $750,000 to $1,000,000.

Kirkland Lake.—It is stated that the Kirkland Lake Proprietary, organized in England with a capital of £200,000, has secured a controlling interest in the Tough-Oakes, Teck-Hughes, and Sylvanite properties in this district, in addition to securing options on other claims. Clement A. Foster, who held the principal interest in the Tough-Oakes, has gone to England in connection with the deal, and a considerable influx of British capital into the district is anticipated. A test shipment of 4 tons of Teck-Hughes ore, sent to a Cobalt smelter, gave gold contents of $38·15, and silver contents of 102 oz. per ton.

JOHANNESBURG.

Retrospect.—The total gold output of the Transvaal in 1913 was 8,795,824 fine ounces, valued at £37,468,024, as against 9,124,299 fine ounces, valued at £38,757,560 in 1912. There was, therefore, a decline of 328,475 ounces, valued at £1,289,536, for which the miners' strike and the consequent labour shortage were entirely responsible. The annual gold production of the Transvaal for the last decade is shown in the following table:

Year.	Fine ounces.	Value £.
1904	3,779,621	16,054,809
1905	4,897,221	20,802,074
1906	5,786,617	24,579,987
1907	6,451,384	27,403,738
1908	7,052,617	29,957,610
1909	7,280,546	30,925,788
1910	7,533,843	32,001,735
1911	8,237,723	34,991,620
1912	9,124,299	38,757,560
1913	8,795,824	37,468,024

It gives cause for some satisfaction to note that the amount paid out in dividends to shareholders increased in spite of the lessened production. In 1912 dividends totalled £8,284,077, and in 1913, £8,578,250, an increase of £294,173. The past year was chiefly memorable by reason of the miners' strike in July and the disorders that accompanied it. But the strike had at least one good result. It brought home to the strikers the boomerang effects of a blow at the industry, and opened the eyes of the citizens of South Africa to the extent to which their own welfare depended on the progress and expansion of the much maligned gold mines of the Rand. Nor was the lesson wasted on the Government of the Union. It soon saw that it must pay increased attention to the relations existing between master and man, and organize the forces of law and order against those of anarchy and civil war. In mining, the anti-phthisis campaign was vigorously conducted with most beneficial results, and safety measures of all kinds received keen attention. The Crown Mines and the City Deep adopted the circular form for their new shafts, and the Meyer & Charlton successfully inaugurated electric blasting. Rock-drills came in for close investigation with regard to air-consumption and maintenance costs, and notable economies were effected. The small hammer-drill attained to great favour, and further developments in the use of these machines are certain. Sand-filling made but little advance, and the problem of economically affording roof-support in deep mines still awaits solution. In metallurgy, the Nissen stamp was recognized as an improvement on the Californian stamp, tube-mill design attracted more thought, and the details of metallurgy and metallurgical management were subjected to a thorough polishing with a resultant improvement of extraction and a lowering of working cost. The sorting question came into some prominence, and was debated in a casual fashion by the opposing schools; the outcome of the debate being the dictum that sorting should be abolished only in the case of a very low-grade mine crushing a large tonnage. During the year the Jumpers, Treasury, and York mines became worked out, and were closed-down; and the Cinderella Consolidated and Jupiter mines ceased working pending the arrival of more profitable times. The only entrant into the ranks of the producers was the Van Ryn Deep. In general, the year was one of marking time, the impossibility of getting capital from oversea on reasonable terms preventing the inception of many mining schemes of merit and seriously hampering several of those already established. The base-metal industry continued to forge ahead quietly, and the producing diamond mines made most satisfactory profits. The present year has begun badly with a railway strike, which has occasioned a feeling of unrest of such a serious nature that it almost requires a rabid optimist to predict anything good for the immediate future. The Government in this case has acted with a promptitude that has earned the hearty approval of all law-abiding inhabitants, and that cannot but have a reassuring effect upon the minds of European financiers and investors. The response of the Active Citizen Force and the Reserve Forces to the call to mobilize and maintain order has been instantaneous and splendid. These are healthy

A KAFFIR BOSS AND HIS FAMILY.

signs of the awakening of the Union to the absurdity of being bullied by the little group of agitators who control the sinister machinery of the Federation of Trades. Allow the railways to be paralysed, and the mines must stop work for want of coal and supplies. The presence of hundreds of thousands of Kaffirs in the centre of disturbance could not be tolerated for a week; they would be repatriated at the earliest possible moment in huge treks under the escort of armed burghers. The final result would be the closing-down of the mines of the Union for six months or a year, with consequences to the country too dire to contemplate. If this contingency ceases to cast a gloom over the outlook and confidence is restored, there is little doubt that a revival of mining prosperity will soon begin to make its welcome presence felt.

Returns for December show that the total number of stamps dropping in the Transvaal was 9722, an increase of 57 on November. Native labour figures show a slight improvement on those of last month, the figures for the last three months being as follows:

	October.	November.	December
Gold mines ...	148,882	147,569	150,012
Coal mines......	9,377	9,286	9,516
Diamond mines	12,712	12,680	11,811
Total	170,971	169,535	171,339

The position compares badly with that of previous years. In December 1911 there were 195,249 natives at work, and in December 1912, 214,915. At least 50,000 natives are required to make things comfortable.

The temperature gradient in the mines of the Rand has been usually taken at 1° for every 254 ft., and in consequence of this remarkably slow increase no fears have ever been entertained that temperature would be one of the factors to stand in the way of exploiting the banket at very great depths. Now comes a rude dissipation of this soothing belief, in the shape of a contribution to one of the societies by Mr. E. J. Moynihan. Working from the records published by the Mines Department, he shows that the increase of temperature is greater than 1° for every 100 ft. in the case of about a dozen mines. In two cases the rate is greater than 1° in 70 ft., and in one case it is as great as 1° in 61 ft. He does not impugn the good faith of the observations that established the extraordinarily low gradient of 1° in 254 ft., but he thinks that certain most important considerations were overlooked; and as the whole question is in a most unsatisfactory state, he proposes to deal with the matter in a short paper at an early date. This paper is anticipated with keen interest. Mr. Moynihan is a lucid writer and speaker, with a reputation for dialectical pungency far above the ordinary.

The Modderfontein Deep continues to open up in a gratifying manner. During the quarter ended December 31 last 4462 ft. of development was done, and 3135 ft. was sampled, showing an assay-value of 11·0 dwt. over 41 inches. Since the commencement of development work, a total of 16,582 ft. has been driven, risen or sunk, of which 13,147 ft. has been sampled, showing an average assay-value of 8·9 dwt. over 45 inches. The present issued capital is £394,500, and the directors are empowered to increase it up to £500,000. A mill with a capacity of 30,000 tons per month is on order, and it is hoped to start production by the end of the current year. Allowing a stoping-width of 60 in. and deducting 25% for pillars, unprofitable ground, and sorting, there remains 20,000 tons per claim on a dip of 8°. The mill would exhaust 18 claims per annum, indicating a life of 21 years. The plant, which will be erected as a complete and final unit, is to comprise 75 heavy stamps and 6 tube-mills. It is expected that the sum of money in hand and to be obtained by the issue of further shares will suffice to bring the mine to the producing stage. So far as development has gone results have been excellent, and the company would seem to have first-rate prospects.

The Consolidated Main Reef accomplished an improved performance during its last financial year, as the following figures show:

	Year ended June 30, 1912.	Year ended June 30, 1913.
Tons crushed	242,416	266,055
Yield per ton	28s. 11d.	30s. 7d.
Cost per ton	21s. 2d.	20s. 1d.
Profit per ton	7s. 9d.	10s. 6d.
Total working profit	£94,134	£139,415
Dividend	8¾%	10%
Balance appropriation a/c	£22,806	£58,659
Ore reserve tonnage	610,680	614,470
Assay value per ton	7·26 dwt.	7·32 dwt.

For the six months ended December 31, 1913, the working profit amounted to £58,132, and on this basis a slight diminution in the dividend appears probable. Capital expenditure last year, however, reached the high total of £87,501 as against £57,890 for the year before, and this year a return to normal expenditure may be looked for, with the result that the decrease in earnings should be balanced by the decrease in expenditure, and the dividend rate maintained. The company has an issued capital of £924,364. The balance of cash available at June 30, 1913, was £87,854, and, generally, the financial position is sound. The results of sampling the levels driven during last year show that 60% of the Main Reef Leader was profitable and 27½% of the South Reef; the Main Reef is at all times almost worthless. The western section was satisfactory, the central section moderately so, and the eastern section so poor that most of the drifts in it were stopped. At the 15th level the so-called Ferreira dike causes an up-throw of 400 ft., necessitating the sinking of a large vertical shaft to open-up what is virtually a new mine. This is a 7-compartment shaft with a hoisting capacity of 150 tons per hour. The lode was intersected in it at a depth of 2365 ft., corresponding to the 23rd level, and the sampling results show that the ore at this point is of excellent value. Sinking was discontinued at a convenient point below the 25th level. The capacity of the plant is from 25,000 to 27,000 tons per month, and the life of the mine is about 20 years. This property and the Main Reef West adjoin one another, use a joint plant, and are under one management, so that an amalgamation is quite probable even for no other reason than as an act of graceful obedience to the dictates of economic fashion.

Ferreira Deep has been doing remarkably well recently, and its last financial year was a record one:

	Year ended Sept. 30, 1912.	Year ended Sept. 30, 1913.
Tons crushed	559,800	647,550
Yield per ton	39s. 11d.	41s. 6d.
Cost per ton	21s. 3d.	20s. 1d.
Profit per ton	18s. 8d.	21s. 5d.
Total working profit	£531,990	£669,214
Dividend	42½%	50%
Balance appropriation a/c	£125,105	£268,267
Ore reserve tonnage	2,070,900	1,970,400
Assay value per ton	9·4 dwt.	8·7 dwt.

For the quarter ended December 31, 1913, the total working profit was £153,668 from 160,320 tons crushed. This result is proportionately not quite up to the high level of the preceding twelve months. The mine has an issued capital of £980,000 and a life of about 7 years. In 1910 a new system of stoping and supporting the hanging wall was introduced to meet the serious position brought about by the severe roof-pressure consequent upon insufficient support. This method consists of the entire elimination of stope-pillars and the close packing of the area stoped with broken ore and waste concurrently with the advance of the stope-faces, 'pig-sties' being used in the wider stopes in place of broken ore. To save the shafts from destruction a vigorous sand-filling programme had also to be carried out. About the middle of 1913 several of the stopes reached the boundary and made it practicable to begin withdrawing broken ore, the stopes being allowed to cave behind as the working 'back' proceeded. As the breaking of this ore has already been charged, its reclamation does not cost much, but the ore and waste have to be handled twice in the stopes, and as there is always the danger of valuable ore being lost through the subsidence of large areas the practice is more a forlorn hope, or a regrettable necessity, than a desirable mining method. During the last financial year 78,801 tons of broken ore were left in the stopes as roof-support, making a total of 146,288 tons packed, and of this 17,619 tons was recovered. Though the development outlook is fairly satisfactory, decreases both in tonnage and value must be looked for, as everything points to smaller lode-widths and lesser yield in depth. This mine experienced the sensation of a violent earth-tremor in the month of December last, and this movement unpleasantly manifested itself by shaking-down some of the crushed hanging wall of the No. 2 shaft, which is in the middle of the sand-filled area, and temporarily preventing hoisting.

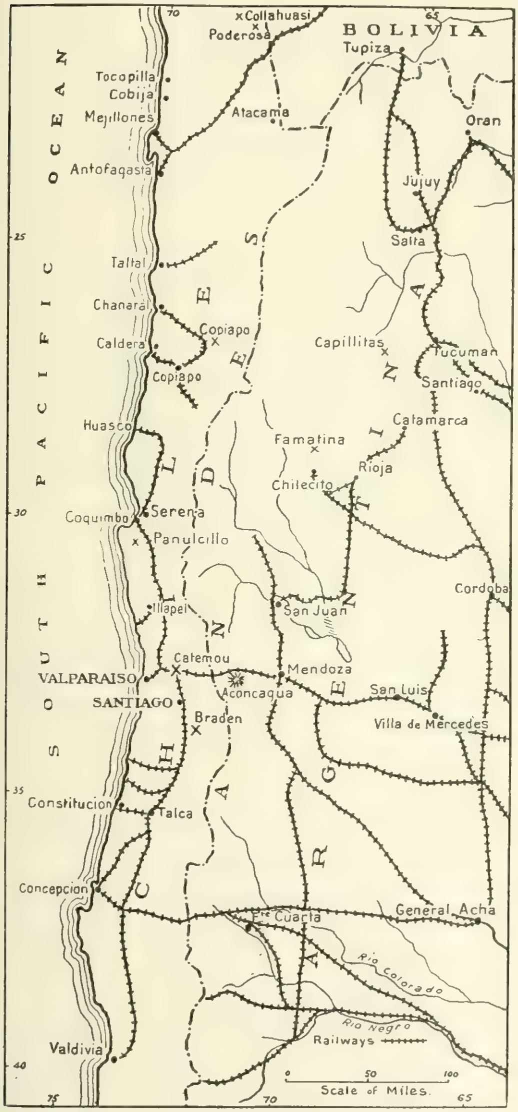
Nairobi in British East Africa has made up its mind to have a flutter in gold mining. The Ngasamo Gold Mining Company has recently been floated there with a capital of £35,000, of which £25,000 is purchase price, and £10,000 working capital. The mine is situated at Ngasamo in German East Africa, and is equipped with a 5-stamp mill, engine, boiler, crusher, and the usual mining plant. Mr. Arthur Jefferies, the details of whose certificates of competency to pass an opinion are not given in the press abstract, reports that the ore averages 1 oz. per ton, and that it is a sound and profitable property. The working expenses are estimated at 10s. per ton. Eleven shafts have been sunk, and £12,000 has been extracted from the mine. There are about 5000 tons of accumulated tailing, valued at £7000 gross. Evidently the 'usual mining plant' is minus a cyanide annex; and a working cost of 10s. per ton in the tropics is scarcely credible; probably 30s. would be nearer the mark. Particulars are not available as to how much of the £12,000 was profit.

NEW YORK

Business Prospects.—Since the beginning of this year everyone has talked optimistically in regard to the future without any definite evidence of an improved situation being visible. But in the third week of January concrete evidence of a most convincing character was forthcoming. The state of New York had authorized an issue of $51,000,000 in 4½% bonds for the construction of highways and canals. This was advertised in the usual way and the entire issue sold at a price of 106 to a syndicate composed of W. A. Read & Co. and Kuhn, Loeb & Co. When this syndicate put the issue on public subscription the following day at a price of 107¼ it was completely sold in two hours, being greatly over-subscribed. This is evidence of the most incontrovertible kind that there is plenty of money available for investment, but the public has become more conservative in its choice of securities and is only anxious to secure those of unquestionable soundness. In other words, this is the reverse of an era of speculation, and business therefore appears dull, but it is all the more sound. As a matter of fact, a good deal of interest in new mining ventures is being exhibited here.

Copper.—The end of the year makes possible a summary of developments in the copper mining industry in this country, and recalls some interesting events. Perhaps the chief of these is the fact that the American Smelting & Refining Company has taken the leading place as a producer and seller of copper. It has long been the leader in the production and marketing of lead, but for copper the leading place has been held by the United Metals Selling Co., the sales agency for the Amalgamated Copper interests. Last year the United Metals sold 442,000,000 lb., while the American Smelting & Refining sold 494,000,000. The difference is really greater than this, for the output of the Braden mine goes directly to Europe, and does not appear in the total for the A. S. & R. In addition, the amount of copper belonging to outside companies sold on commission by the United Metals is three times greater than the amount of similar material marketed by the A. S. & R. This commanding position is the more remarkable in that it is the result of the growth of a decade, the company having first developed its Mexican copper properties and then acquired a large interest in the Utah Copper, Nevada Consolidated, Ray Consolidated, and Chino, four properties which together produce nearly 300,000,000 lb. per year. The important effect of these large properties on production is not generally realized. A 5% increase or decrease in the output of these mines is the same as doubling or reducing to zero the output of such well known properties as Tennessee Copper or Granby. As the September production of Utah Copper was 20% greater than its output in July, it is evident that such large mines, merely through natural fluctuations, such as a period of cold weather when the ore freezes in cars and bins, or a period of drought, when the water supply for milling is short, cause large fluctuations in the output of copper.

The Braden, by the way, is developing into a much larger mine than was at first expected. Last April Pope Yeatman, the consulting engineer, estimated the ore reserves at 16,000,000 tons of developed ore, and a total of probable, possible, and developed ore of 44,000,000 tons, averaging 2·63% copper. In a recent letter, Mr. Yeatman, who is now at the property, makes an estimate of 34,000,000 tons of developed ore, and a total, probable, possible and developed, of 78,000,000 tons of 2·8% copper ore. As he estimated in 1911 there were 10,000,000 tons of 2·7% ore developed, the increase is decidedly gratifying. A further cause for congratulation is the way in which the expected extraction has been exceeded. The estimate in 1911 was that 65% of copper present could be extracted. Since then the Minerals Separation flotation process has been adopted for the treatment of the tailing from wet concentration and the total recovery in one of the two mills during December was 80% while the other made a 70% recovery. The higher returns were made in the plant that Walter Broadbridge is re-adjusting on behalf of the Minerals Separation so as to get better results than the local staff have been able to obtain. If both mills are eventually able to attain an 80% recovery when operating at full capacity, this alone will represent nearly a 25% increase in the output of copper as compared with the original estimate. This is all very roseate, but the fly in the ointment is the question of cost of production. The 1911 estimate was that the copper could be laid down in the market at 7½ c. per lb. On this basis the Braden should have a profit of over $1,200,000 for the past year. No figures have been given out, but as there have been rumours during the year that Braden would have to do some new financing, it is scarcely probable that the results have been anything like so favourable, and in all likelihood the cost has been not less than 10 c. per pound. There is no question that the Braden has a large reserve of good ore, but the vital question as to how much profit is going to be made in taking it out does not seem to have been answered with any precision as yet.



Map showing position of Braden Copper Mine.

San Domingo.—Hope springs eternal in the human breast and faith in discredited mining districts seems to be perennial. An excellent instance of this is the Yaquin and Haina river district of the island of San Domingo, which for forty years past has attracted group after group of credulous investors. So long ago as 1870 a commission, sent by President U. S. Grant, investigated the area and found it unprofitable. Sundry local people, who have everything to gain and nothing to lose in attracting outside capital, were undeterred by this, however, and ever since have been busily engaged in presenting it to anyone who possesses money, with discouraging results to the investor but much to their own profit. The country adjacent to these two rivers has considerable areas of gravel of such a character and so situated as to be attractive as the basis of dredging or hydraulicking. Along the edges of small streams the natives pan out small quantities of gold, and so, early in 1913, a group of New York and Philadelphia speculators sent a party, under the charge of a capable and experienced engineer, to drill the ground and determine its value. Several Empire drills were employed and the results were at first encouraging, but proved peculiar enough to arouse suspicion. After a large amount of expensive work had been done the fact was finally detected that the native crews were experts at the game of salting and, with the aid of a little clay and the gold recovered from the native work along the streams, had salted the drill-holes with a degree of skill that defied the most careful watching. The most embarrassing thing to the engineer was the fact that he carefully coached his drill-crew to teach them how to avoid being salted, only to find that he had thereby imparted to them the knowledge necessary for them to successfully carry on the salting themselves.

SAN FRANCISCO.

Mexico.—Reports from northern Mexico are to the effect that the Constitutionalists are repairing the railroads north of Torreon and that the smelting plants at Velardena and Chihuahua are expected to be able to blow in again in a month or so. This would give the A. S. & R. three plants in operation, or about two-thirds its normal capacity. The Smelting company is paying its taxes both to the forces in control in the north and also to the government, or lack of one, in Mexico City. This makes a double burden, but in view of the uncertainty of the situation in Mexico it seems to be a good investment.

British Columbia mines have had a record year from the standpoint of dividends at least. The Standard Silver-Lead Mining Co. has paid $650,000, the Hedley Mining Co. $360,000, Consolidated Mining & Smelting Co. $464,416, Granby Consolidated Mining, Smelting & Power Co. $899,911, British Columbia Copper

Co. $88,756, Le Roi No 2, Limited, $43,200, a total of $2,506,283. This, of course, does not represent the total of profits, for many companies have made profits in excess of the dividends paid. Prospecting has been most active along North Thompson river, the north fork of Seymour river, Eldorado and Taylor creeks, and on McGillivray mountain, in the Lillooet district, and some encouraging results have been attained. Placer gold production is estimated at $550,000 for the year, mostly from the Atlin and Cariboo districts.

Western mine-owners and engineers are interested in a number of phases of proposed legislation at Washington, though they are paying little attention to the actual progress of events. The ship of state seems, however, in a fair way to make rapid progress even if few passengers are on the deck advising the captain. With tariff and currency legislation out of the way, and a programme regarding trusts laid down, the Administration is devoting serious attention to constructive work regarding conservation, the public lands, and internal administration. A bill is being debated by the Senate which provides for Government ownership of railways in Alaska and the building of the much needed trunk-lines to the interior. It seems altogether probable that the bill will be passed and $35,000,000 devoted to the task. This does not necessarily mean that the Government will operate the roads when built, as it is open to the President to lease them to an operating company, if suitable terms can be made. Under the terms of the bill the Government is to acquire by purchase the existing lines, and it is an interesting contrast to the state of public opinion three years ago that all this programme provokes but little determined opposition. The people have, apparently, made up their minds that railroad-building in Alaska is a national duty and that the inevitable initial losses had better be faced by the Government than shouldered off upon some syndicate that would have to balance them by possibly unfair exactions on the industries of the tributary country. It is pleasant to record that the Kennicott Mines Co. has just paid another dividend of $1,000,000, making a total of $5,000,000, so that the mining department of the Alaska Syndicate shows a profit even if the railroad is yet a loss.

Coal land legislation may be expected to follow quickly after the settling of the Alaskan railroad controversy and less certainly this will be immediately followed by enactment of new laws governing the disposition of petroleum, phosphate, and potash lands. Franklin K. Lane, the Secretary of the Interior, himself a Californian and thoroughly familiar with the West, has recommended a leasing system for all these classes of lands, but definite draughting of a law is yet to be accomplished. It is fair to say that the proposed leasing system is unpopular throughout the West. At the same time it is likely to be adopted because the sentiment of the country as a whole favours it, and the West will accept it rather than endure indefinitely the present conditions under which large areas have been withdrawn and are closed to development of any kind. Temporarily this has worked to the advantage of many producers. There is now an over-production of power and petroleum on the Pacific coast and lands already patented or covered by location before withdrawal are capable of more than meeting present demands for coal, potash, and phosphate. It is for this reason that the Conservation programme met no stronger opposition. Had there been any real shortage of material or power it would have been swept aside long ago. The typical Westerner, however, is not satisfied with this. He wants to develop and promote new properties anyway, and he has seen too many fortunes quickly made to give over easily the promotion of new enterprises.

Colorado men are among the unreconciled. Mining has not been as active in the Centennial state the last few years as in days gone by and the majority of those who talk and write, at least, lay the blame largely on the new land policy. The Secretary of the Interior recently asked Congress to grant authority to withdraw radium lands and promptly Colorado sent a delegation to protest. It happens that the best known sources of radium are in Colorado and the Standard Chemical Co. of Pittsburgh is already refining ore from Colorado. Recently Dr. James Douglas, of the Phelps Dodge company, and Dr. Howard Kelly of Johns Hopkins, joined in the formation of a National Radium Institute to make sure of securing an adequate supply of radium for the hospitals under their control. Arrangements have been made for a supply of ore from private lands and for the Bureau of Mines to supervise the technical work with full permission to make all results public. The Secretary of the Interior now proposes to withdraw public lands so as to secure at the same time a supply of radium for government hospitals and there is a big protest. The Standard company has carefully guarded its methods of refining as a trade secret, and the proposed publicity by the Bureau of Mines is more than suspected to be one cause of dissatisfaction by the Standard and its Colorado friends.

CAMBORNE.

West Kitty.—I referred in my December letter to the improved prospects of this property. The Wheal Friendly shaft is being sunk to intersect the lode from which the increased returns are being made, and when this has been done, the working cost should be considerably decreased. The financial position of this company, as disclosed by the statement of account for the 15 months ended March 31, 1913, is by no means so satisfactory. During that period, £25,000 6% convertible first mortgage debentures were authorized, the whole of which were taken at par by the St. Agnes Consolidated Mines, Limited. This foreshadows that the West Kitty company will subsequently be merged into this controlling company. The expenditure on development and establishment account for the fifteen months was £33,979, and the receipts (including the sale of 165 tons of black tin) amounted to £23,194, the difference of £10,785 being charged to capital account. It is a matter for comment that the accounts, presented at the meeting held on December 31 last, were only made up to March 31, 1913, while a neighbouring mine is able to issue its accounts to December 31 last within four weeks.

The report and accounts of the St. Agnes Consolidated Mines, Limited, also made up only to March 31, 1913, show that the expenditure on the East Blue Hills property for fifteen months was £7500, and the London expenses, together with bond interest, at £4170, making a total of £11,670. The income from tin sales and interest was £8425, and the difference of £3245 was charged to capital account. The following analysis of the balance sheet of this company may prove of interest:

LIABILITIES.

Issued Capital	£137,900
6% Participating Bonds	34,335
Sundry creditors	23,035
	£195,270

CORDOVA, ALASKA: A terminal of the Alaskan railway.

ASSETS.

Purchase of properties	£137,596
Shaft machinery, plant, &c.	1,890
Development account	10,857
Investments (at cost) in West Kitty	37,559
Commissions and preliminary expenses	2,601
Loans, cash and sundry debtors	4,767
	£195,270

The only property being worked by the company is the East Blue Hills mine, and this only by tributers above adit, while the company, as will be seen above, has a controlling interest in the West Kitty mine.

Botallack.—All work at this St. Just property has been stopped and a receiver appointed in the interests of the debenture holders. The developments in the Botallack section of the property were of such a character as to discourage any further expenditure there, but the Eastern or Wheal Cock section is certainly worthy of a trial. Originally it was this section that it was proposed to re-open, but the mistake was made of changing the programme, when it was thought, owing to various unoreseen difficulties, that the capital was likely to prove insufficient. The Botallack section offered a more immediate prospect of yielding ore for the mill, and no doubt, with a view to avoid an appeal for more capital, the changed plan was adopted. It has proved an expensive mistake, for further capital was needed after all, while local people are still of the opinion that the section with the best prospects has been neglected.

Wheal Hermon.— It is fortunate that with the closing of Botallack another source of employment is open to the discharged miners. This is the Wheal Hermon property, situated about half-a-mile to the south of St. Just, and owned by H. F. Olds, who is also connected with the management of the Levant mine. Mr. Olds has opened up this mine above water-level and equipped it with 15 Cornish stamps, run by water power, together with the necessary dressing plant. According to my information, the ore will average 15 lb. of black tin per ton. There is sufficient ground above adit to last for many years on the present scale of working. Mr. Olds has thrown open the property to the discharged Botallack miners to work on tribute.

Dolcoath. — The following comparative figures, coupled with the fall in the assay-values of the chief development points, will account for the drop in the price of the shares:

	6 months ended June 30, 1913.	6 months ended Dec. 31, 1913.
Ore crushed	58,304 tons	56,408 tons
Black tin sold	787 ,,	738 ,,
Average recovery in lb. per ton	30·3	29·3
Value of tin sales	£105,965	£79,673
Average value per ton of ore	36s. 4d.	28s. 3d.

A dividend of 6d. per share, absorbing £8750, will be recommended; this compares with 1s. per share paid in August last. Thus the dividends for the past year will be 7½%, compared with 20% for 1912.

Carn Brea & Tincroft.—On January 17, all work underground at the Carn Brea section of this company's mines was stopped. The pumping engines at Old Sump and Macdonald's will, for the present, be kept working, and the cost of this, I understand, will be largely borne by the 'lord,' A. F. Basset. The management will concentrate their efforts on the North Tincroft section as recommended by James Brothers in their recent report; this is undoubtedly the right policy in view of the limited resources of the company. If the average content of the ore is maintained, this section of the mines ought to prove profitable at present prices. It is proposed to sink Tyre's shaft, which should increase the reserves considerably; but this will involve the outlay of much capital, and the scheme will therefore be probably held up for the present.

Clay-workers.—The West of England China Clay Co., the largest of the clay-producing companies in Mid-Cornwall, has recently concluded an arrangement with its workmen, both union and non-union. A conference was held, at which representatives of the company, the non-union employees, and the union men were present, while permission was accorded the union officials to accompany the latter. This is the first recognition of the Workers' Union by any of the China Clay companies in the West of England. It is a wise move, for trades unionism has now a firm hold in the district. The refusal of the employers in the recent strike to recognize the union was, as I wrote at the time, one of the things difficult to understand, seeing that they themselves had combined to protect their interests. Under the agreement, clay-breakers and washers will be paid 7d. per hour, while 3½d. per hour will be paid when stopped by wet weather. As neither side has any actual experience of the amount of time lost through wet weather, the company undertakes that no workman's wage shall be less than 22s. 6d. per week. Each shift will appoint a representative to notify the manager when the men wish to cease work owing to wet weather, each stoppage to be not less than half-an-hour. Blacksmiths, carpenters, and enginemen will be paid not less than 7d. per hour, with no lost time through wet weather. The agreement will be in force for three years, and during that time there shall be no partial or general stoppage of work. All questions shall be discussed by the company with the Workers' Union, and failing a settlement, they shall be referred to the Board of Trade for final and binding decision on both parties. Under this agreement, and working 7½ actual hours per day, the men can earn 26s. 3d. per week, with a minimum of 22s. 6d. This minimum is only 2s. 6d. below the minimum demanded in the recent strike.

Wheal Kitty.—The report and statement of account for the six months ended December 31 last show that 101½ tons of black tin was sold, realizing £11,211, or an average price of £110. 9s. 6d. per ton. The total receipts figure at 30s. 1d. and the costs at 27s. 8·33d.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

Jan. 1914	Dec. 1913	Jan. 1913.
£64. 8s. 0d.	£65. 5s. 7d.	£71. 18s. 6d.

The publication of the last American statistics showing such inconsiderable deliveries to American consumers has been followed by bewildered comment among dealers. In spite of the poor showing, and the addition of 22,187 tons to the world's stocks in the course of a single month, operators have judged it advisable to close their bears, and the market has since shown a steady upward trend. Much is made of the fall in trade here as well as in America, but the continued heavy shipments of electrolytic copper that are reaching Europe indicate that the end of the boom is not yet. The easier money rates may speak of slacker tendency in trade, but are also evidence of accumulated profits seeking re-investment which will stimulate fresh enterprise. The market is no doubt at present discounting the future, for inquiry is slack, except in America, where demand has to make up the arrears of December. Standard three months opened the month at £64. 15s, declined to £63 on receipt of the American figures, and closed at £66. 5s. Apart from easy money and hopeful sentiment, there is little to indicate higher prices.

TIN.

Average prices of cash standard tin:

Jan. 1914	Dec. 1913	Jan. 1913.
£172. 0s. 11d.	£171. 18s. 11d.	£228. 5s. 0d.

The turn in the tide of declining prices seems to have come at last. From the low level of £168. 5s. for three months tin, prices have been raised to the neighbourhood of £185. The efforts of the bull syndicate are being assisted by general sentiment and cheap money, and the doubts that were lately expressed as to the success of their operations are no longer heard. Some of the advances registered have been startlingly violent. It is deplorable that dealings in this article should evolve such pyrotechnic displays. It is bad for producer and consumer alike; it lowers dealing to the level of 'beggar-my-neighbour'; it introduces into sober trade the worst methods of the Stock Exchange. In view of the Banca sale, the rise was generally unexpected, and the high level of £179. 10s. realized for the 2350 tons sold was the signal for a scramble both by bears and outside speculators for the rise. The intervention of the latter is likely to make the market in the near future exceedingly sensitive. Confidence is given to their operations by the renewal of demand from America. Consumption in South Wales is quite brisk.

LEAD.

Average prices of soft foreign lead:

Jan. 1914	Dec. 1913	Jan. 1913.
£18. 19s. 9d.	£17. 8s. 8d.	£17. 1s. 11d.

The scarcity of this metal continues without relief. Allured by the tradition of winter's lessened demand, dealers had committed themselves heavily on the bear for December, January, and February. The short supplies have driven them to cover at rapidly advancing prices, and a large business had taken place on the exchange at £20 and over for these deliveries. As we write the market is inclined to sag, covering operations having ceased, but buyers must bear in mind that supply is barely sufficient to meet demand, and they should seize the opportunity afforded by any fall to cover their forward requirements. Even if the Mexican troubles were to cease, it will be months before material from there can come forward.

SPELTER.

Average prices of good ordinary brands:

Jan. 1914	Dec. 1913	Jan. 1913.
£21. 9s. 9d.	£21. 6s. 5d.	£25. 19s. 1d.

Prices are without change at £21. 7s. 6d to £21. 10s. for ordinaries, and £21. 15s. to £22 for specials. Demand is fitful, and there has been no animation in the market. It has been definitely decided to form the Association of Galvanizers, and this step has given rise to a cheerful feeling in the trade. At the meeting of the spelter convention early this month it was resolved to make no alteration in prices.

OTHER METALS AND MINERALS.

Prices quoted on February 10:

SILVER.—26½d. per oz.

PLATINUM.—185s. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£81 to £83 per ton.

NICKEL.—£170 per ton.

ANTIMONY.—£29 to £30 per ton.

ARSENIC, WHITE.—£13. 10s. per ton.

QUICKSILVER.—£7. 10s. per flask.

MANGANESE ORE.—8½d. to 10d. per unit.

IRON ORE.—Cumberland hematite 20s. 6d. per ton at mine. Spanish 18s. delivered.

PIG IRON.—Cleveland 52s. per ton. Hematite 61s. per ton.

WOLFRAM ORE.—33s. per unit (1%).

The Institution.

On the occasion of the formal opening of the new home at No. 1 West Street, Finsbury Circus, the President, Mr. Bedford McNeill, addressed the Lord Mayor as follows: My Lord Mayor and Gentlemen: The necessity for such an Institution as ours is proved by what we have already accomplished. Our chief aims are to advance the science and practice of mining and metallurgy, and to raise the status of our profession. From a comparatively small beginning we have steadily risen, year by year, in numbers and importance, and with increasing usefulness, we claim to have made considerable progress towards attaining the objects which the founders started out to secure. Today is the twenty-second anniversary of our foundation, and today finds us firmly established as freeholders in this ancient city. We feel, my Lord Mayor, that your having so kindlv consented to honour us today with your presence is significant of our work and aims, and of our admission into these associations of men, which, for ages past, have made the name of the City over which you preside synonymous with efforts for the public good. I need not remind you that practical metallurgy is extensively represented in London by the refining of gold and silver. During the year 1912 (the latest year for which the figures are available) the gold melted at the Royal Mint and other refineries was 508 tons, and London still maintains its pre-eminent position as being the only free market for gold in the world. If there is one truth that science tells us as certain, it is that there is no such thing as absolute cessation in Nature. You cannot stand still. If you do not progress, you are inevitably and relentlessly driven back. To maintain even our present standard of excellence we must advance. If we do not, then we must be prepared to yield to others the position which we ought to occupy. It is our belief in the higher aims of our Institution (which, by appropriate tests, excludes the unqualified) that has induced us to enrol ourselves as members, and this is the reason why we are about to petition the King in Council to grant us a Royal charter—a charter which will recognize our corporate existence as metal miners and metallurgists, and by that recognition confer the right of doing still more good for the community. My Lord Mayor, permit me to say that I regard with the greatest felicity the fact that I, as representing the Council and some 2400 members of this Institution, have the honour of asking you to accept this key. The initials—I.M.M.—of our Institution form the wards of the key, and although it will not serve to open the material door, it will be symbolical to you as signifying that you have unlocked the entrance to this Institution, and that you are, and ever will be, more than welcome to come amongst us. I now ask you, my Lord Mayor, to kindly declare our building open.

The Lord Mayor, on rising to reply, was enthusiastically received. He said: Mr. President and gentlemen, first of all let me thank you for the very kind reception you have given me here today. I can assure you it has not been the slightest trouble to me to come here, but, on the contrary, it has given me a great amount of pleasure, because I recognize that an Institution such as this is for the welfare, not only of the members themselves, but for that of the kingdom at large. It is very interesting to know that you have made such great strides, as I see by the circular you have issued, that in a very few years, from the membership being 585, it has now grown to 2372. You can rely upon this, that these new premises (which, I can see, are very convenient and commodious) will still further increase your membership and the good work you are doing. I think the object you have in view of obtaining a Royal charter, very laudable, and I sincerely hope His Majesty the King will see his way to grant it to you, because everyone knows that, when once an Institution gets a Royal charter—I do not know why it should be so—it acts as an incentive for those belonging to the profession it represents to more readily combine for the public good. It has been a great treat to me, and I know to the Sheriff, to come here today to, what we will will say metaphorically, open the door of this building. You have told us, Mr. President, that you are freeholders, and that shows to me that the Institution must be in a very flourishing condition. Long may it continue to be so, and, if by my visit here today I have assisted you in any possible way I am more than repaid. Allow me again to thank you most sincerely for this valuable memento of what to me is a very interesting occasion. I now declare formally this Institution opened, and I wish it all success.

Mr. Edgar Taylor (Past President) said: It is permitted to me, as the Treasurer of this Institution, to ask that you shall resolve a most cordial vote of thanks to the Rt. Hon. the Lord Mayor, for having so courteously and so kindly opened this new home of our Institution. I need not say that, with the Lord Mayor's public engagements, which are

THE HOME OF THE INSTITUTION.

many, we must not detain him by any speech making, but I would like to assure his Lordship, on behalf of the President, Council, and members, as well as our officials, of our deep gratitude to him for having come here to undertake this ceremony. I feel sure that, when Dr. Hatch has seconded my proposal, you will carry it by acclamation.

Dr. Hatch: Mr. President and gentlemen, in seconding this vote of thanks, I wish to endorse what has fallen from our President and Treasurer, and to emphasize for my own part the appropriateness in such an important event in the history of our Institution as the completion of this building, of its inauguration by the chief magistrate of the City of London. Ours is, emphatically, an Imperial Institution, for our members are employed in all parts of the Empire, and indeed in all quarters of the globe. In the future this building will be the Mecca to which they will turn for inspiration while they are away, and the centre to which they will gravitate when they return to the old country.

The motion was carried by acclamation.

The Lord Mayor: Gentlemen, I really must add a few words of thanks (though I had expressed them in my earlier remarks) after the kind way in which the Treasurer and President-elect have so kindly proposed this vote of thanks, and after the very gracious reception it has received at your hands. In thanking you once more I would say, as we do of the old City Livery companies: "May this Institution flourish root and branch for ever."

Special Lectures.—During the week beginning January 19 a course of five lectures on 'Geology Applied to Mining' was given by Mr. T. A. Rickard, A.R.S.M., at the Royal School of Mines. These lectures are noteworthy as the first given in the new geological lecture-room, and also as an effort to bring experienced men from outside to address the students on special subjects, linking science to industry. Sir Alfred Keogh, K.C.B., the Rector, presided. The lectures were attended by a goodly number of professional men from the City, and had the effect of making the Royal School of Mines known physically to many who had never been there before. We hope the Governors of the Imperial College will arrange for further lectures of the same kind from other men having special knowledge on one or other of the many aspects of mining, engineering, and metallurgy. It is good for grown men to sit by the side of young students—good for both, for experienced men realize the benefit of continuing to study, while those on the threshold of a career infer the practical application of their academic instruction. Lectures on "border-line subjects," as Professor W. W. Watts expressed it, are useful in illustrating the co-ordination of science and the interplay of various branches of knowledge. We hope that engineers—specially R.S.M. men—will come forward for the performance of this useful service.

University Annexation.—When presiding at the Convocation of the University of London, on January 16, Sir Edward Busk stated that there was no probability, during this session of Parliament, of any bill being introduced to give effect to the report of the Royal Commission on educational arrangements. We understand that a healthy opposition to some features of the proposed agglomeration has been developed. The friends of the Imperial College regret to see its useful work suffer interference, and in this view of the matter they are supported cordially by the Institution of Mining and Metallurgy, a protest from which was published in our January issue. The Institution also fears the injury that may be done to the Royal School of Mines, by further smothering it amid a new agglomeration. The outcome depends largely on the City Guilds Institute, which, through its City affiliations, is in a position to exercise a preponderating influence. We hope that enlightened views will prevail.

R.S.M. Association.—The annual meeting of the Association will be held at 4 p.m. on March 18 at the Mining and Metallurgical Club, 3, London Wall Buildings. At 7.30 on the evening of the same day (Wednesday, March 18) the first annual dinner of the Association and the 41st School of Mines dinner will be held at the Café Monico. Tickets can be obtained from the Hon. Secretary, Mr. T. A. Rickard, 724, Salisbury House. The price is 10s. 6d. only. The chair will be taken by the President of the Association, Mr. William Gowland, A.R.S.M., F.R.S., Professor of Metallurgy. The fourth-year students at the Royal School of Mines will be the guests of the Association. It is expected that the attendance will be large and representative. Applications for tickets are invited without delay. Addresses of R.S.M. men are wanted, so as to make the list as complete as possible. Owing to their nomadic habits, it is difficult to obtain correct addresses.

PERSONAL

F. J. BEDMAN is engineer in charge of the Vereeniging electric-power station in the Transvaal.

JOHN A. BEVAN has gone to Secondi, on the Gold Coast, returning in two months.

CHARLES P. BERESFORD has left London for the Prestea Block A mine in West Africa.

F. K. BORROW, of Pellew-Harvey & Co., is expected from Colombia in March.

R. W. BROCK, director of the Canadian Geological Survey, has been appointed Deputy Minister of Mines.

PETER CLARKE is here from Porcupine, Ontario.

T. W. TEAGUE CURNOE has returned from Northern Nigeria to Newquay, Cornwall.

SCAER CURTIS is here from Rhodesia.

I. D. D. DAIMPRE sailed for Sudbury by the *Canadian* on January 16.

S. H. DE LA MARE has gone to Bucharest.

J. N. V. DORR is at Cobalt, Ontario.

S. EARDLEY-WILMOT has returned from Burma.

J. F. B. ERDLETS is now in the Balkans.

ROWLAND C. FEILDING has resigned from the board of the Socorro Gold and Silver Mine, Ltd.

COLIN FRASER left for Australia on February 4.

H. A. GUESS is now consulting engineer to the American Smelting & Refining Co., New York.

F. H. HATCH, who is consulting engineer to the Kirkland Lake Exploration Co., has gone to Canada.

E. MACKAY HERIOT has come to London from Spain.

KARL A. HINDE has joined the metallurgical staff at Tanalyk.

ROSS B. HOFFMANN and JOHN D. HOFFMANN are here from California.

L. F. S. HOLLAND has opened an office in the Hellmann building, Los Angeles.

CARADOC JAMES left on February 10 for Tarkwa, West Africa.

CHARLES JANIN has left London for the Northern Ural.

R. C. JENNINGS is due shortly from the Belgian Congo.

T. J. JONES, formerly English general manager for the Kyshtim Corporation at Kyshtim, has been appointed supervising engineer for the Kyshtim, and technical advisor for the Tanalyk and Russo-Asiatic Corporations, with headquarters at No. 1 Nevsky Prospect, St. Petersburg.

W. H. LANAGAN is returning to the Orsk Goldfields in Eastern Siberia.

GEORGE MACFARLANE has returned from the Gold Coast.

H. R. MACKILLIGIN, of Lichtenberg and Mackilligin, is on his way to Broomassie, West Africa.

W. SEWARD MANN is erecting a cyanide plant for the Socorro Gold & Silver Mines, in Honduras.

G. B. MASSEY, Jr., of the Bucyrus Company, is expected in London.

GEORGE T. MAUNDER has been appointed assistant geologist to the government of Queensland.

LOUIS D. MILLS passed through London on his way to Johannesburg.

C. H. OLIVER is returning to Hastings from West Africa.

ERNEST V. PEARCE has resigned as manager for the Hungarian Tin Smelting Works, and is now at Penzance.

W. PELLEW-HARVEY has returned from Russia.

W. S. ROBINSON sailed for Australia on February 4.

S. N. RODDA has been appointed director of the Workingmen's College, the principal technical school in Melbourne. He was previously manager of the Mungana mine, Queensland, and of the Torrington mine, in New South Wales, belonging to the Broken Hill Block 14 company.

W. E. SEGSWORTH returned to Toronto on February 7.

W. E. SIMPSON has gone from Cobalt to Mexico.

H. ROSS SKINNER has returned to Johannesburg.

LESTER W. STRAUSS is in Chile.

ARTHUR E. TAYLOR (of John Taylor & Sons), accompanied by Ernest R. Woakes, has gone to Spain.

ARTHUR THOMAS has left for Huelva, in the south of Spain.

WILLIAM TRURAN sailed by the *Megantic* on January 29 on his way to Oklahoma.

R. C. N. TWITE has left for Siam and Lower Burma.

J. L. WALTON is now with the Broomassie Mines, in West Africa.

D'ARCY WEATHERBE sailed on the *Olympic* on January 21 on his way to Cobalt.

G. SEMEN WEINBERG passed through London on his way from New York to St. Petersburg.

FRANKLIN WHITE is returning from New South Wales to London.

A JOURNEY IN MANCHURIA.

Methods of Travel. Mineral Resources. Metallurgical Methods. Bandits.

By STANLEY H. DE LA MARE.

FORTUNATELY most mining men are accustomed to discomforts; they are therefore usually able to make the best of rough accommodation and to swallow indifferent or badly cooked food, even if they do not digest it.

In making a journey of 100 miles to a mine, from Chan-chun, an important railway junction in the Kirin province of Manchuria, by Chinese carts at the beginning of the thaw, even a confirmed optimist would at times have let forth a growl. The average pace was just over 3 miles per hour (10 *li*) for 10 to 12 hours per day, with about an hour's stop at mid-day for food for man and beast. To sit inside the cart all day was unbearable, and to walk meant wet boots that froze hard in the late afternoon.

A typical inn of the district is shown in one of the photographs with a travelling cart in the fore-ground. It consists of a long thatched building with the kitchen at one end, the flues from which run through two raised benches six feet wide running along each side of the room. These are known as the *kong*, or bed, and on them one eats, sleeps, and sprinkles Keating's powder. The only heating arrangement is the *kong*, except a charcoal-brazier for making tea. There is no privacy and there are often 50 men sleeping in the one building.

All carts have wooden axles; on the travelling carts the wheels are loose, but on the heavy carts the wheels are fixed, which makes it extremely bad for the animal in the shafts as they often pull a load of over 3000 *jing* (4000 lb.) in the winter when the roads are frozen.

The Manchurian ponies are justly noted for hardiness and are of an extremely good type with plenty of bone. One sees occasionally a perfect shire horse in miniature, and although a Chinaman seldom rides faster than a shuffling trot, which is closely allied to the South African 'tripple,' it is not difficult to pick up a really good galloper.

Mules are used widely, but they run to leg rather more than they should. Probably nowhere are draught animals better fed. Chopped straw and millet with soaked bean-cake are given without stint, and it is extremely rare to see a bad tempered animal or one that is head-shy, a great contrast to the mules handled by a Cape boy.

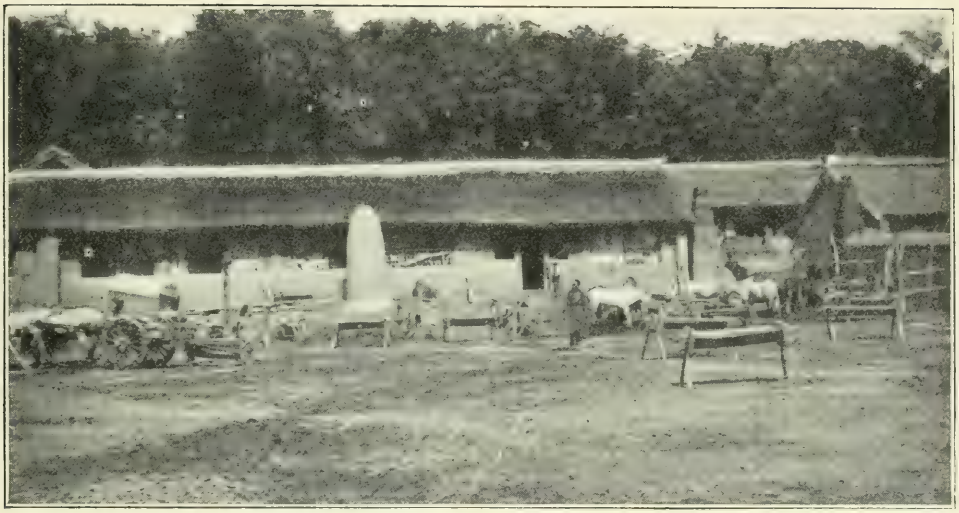
When travelling, the animals are tied in the open, no matter how many degrees below zero the temperature may be, and even at the end of a journey or when not working they are not allowed to lie down, as it is supposed that they will get stiff and in consequence they are on their legs for months and even years at a time.

It is well known that there are no roads in China. This is true of this particular district, although it would take very little trouble or expense to drain some of the worst places and make them passable for a light cart. At present, for months on end it is impossible to move anything and very difficult to get a pony through, marvellously clever as they are in soft ground.

Kirin is one of the best timbered provinces of China. Elm, ash, oak, fir, lime, and walnut are the usual sorts, but being of quick growth are softer than the English varieties, though they stand fairly well underground, probably owing to the cold temperature there being unfavourable to the growth of moulds and fungi.

Manchuria is said to be rich in minerals of all kinds, but it is easy to be in the country for some months without being favourably impressed by its possibilities as a mining region. Possibly the fact of its being snow-covered for six months and overgrown with vegetation for another four, rendering it difficult to prospect, may have something to do with it, as well as the heavy overburden of soil; but indications or legends of mineral deposits are scarce, taking into consideration the knowledge most of the inhabitants have of anything valuable and their ability to extract it as long as they can cope with the underground water.

There are no mining laws and permission to work a deposit is obtained through a friend at court, whose friendship requires continuous refreshing. Should there be a change in personnel it might cost more to cultivate a true brotherly feeling than the mine is worth. Europeans are not allowed to own and work a mine.



A ROAD-SIDE INN, MANCHURIA.

MULE TRANSPORT.

In one particular instance a copper mine had been worked for eight or nine years by 'officers' and the eyes of the mine had been picked out; then a southern iron merchant was let in by making him a Director of Mines, and he had been working for two years without getting much more than working expenses out of it, when he decided that as the hill was a large one there must be a corresponding amount of copper waiting to be got out, and therefore it would be the proper thing to get a European engineer and to induce some foreign merchant to supply him with a modern furnace that would smelt about 10 tons of ore per diem. As the output from the mine was, at that time, with difficulty kept up to 3 tons of 10% ore with home-made black powder, the first necessity was a modern explosive and fuse; but after months of negotiations it was discovered that the mine was only held on a prospecting permit, probably to avoid paying a tax, consequently it was impossible to get a *hood-zow*, or permit, to import a foreign powder under the circumstances. Possibly the political situation would have been an obstacle in any case. Further, the rumour had gone round that foreigners had a financial interest in the mine and the owner was liable to that drastic form of punishment known as 'cut-head.'

The fuse used could hardly be described as belonging to the 'safety' brand. It is made by taking a strip of paper, about 20 inches long by 1 in. wide, along which is laid a train of powder, it is then twisted and placed inside a split reed, which is then bound with fibre. The rate of burning depends somewhat on the amount of ramming that is done to the charge, varying from, say, five seconds to two minutes. It can be well understood that accidents are not unknown.

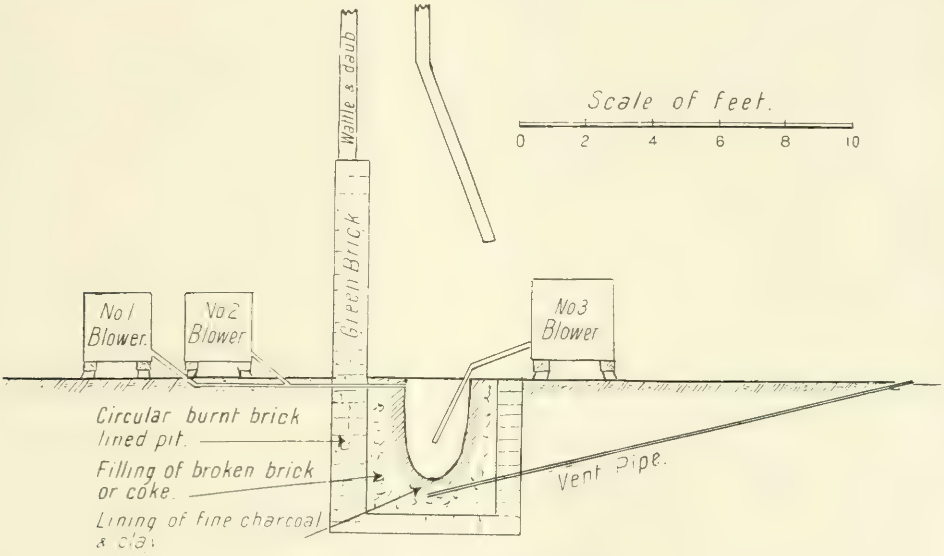
A short description of the metallurgical operations may be of interest. All ore broken was hauled to the surface in baskets by windlass and the waste roughly sorted by the miners, who then carried it to the sorting-floors, where it was again sorted into No. 1 grade, clean chalcopyrite; No. 2, about 10% ore; No. 3, 1·5 to 2%; and waste. Azurite, in spite of daily protests, always seemed to find its way into the waste-dump. The sorted ore was then weighed and credited to the miners at 32 cents per picul (133 lb.) for No. 1; 30 cents for No. 2; 18 cents for No. 3. What that really represents in English money is extremely difficult to fathom as the money was paid in *di-ows*, a local paper currency usually worth about six to the small coin dollar, which had at the time a relative value of 120 to 130 cents for $1 Mexican. After weighing, it underwent a rough calcination in open stalls holding 12 to 15 tons. The time occupied was 4 to 5 days. The smelting required about 650 *jing* of wood-charcoal and coke per charge of 1000 *jing* (1333 lb.) of ore; this included wood used in calcining. Labour was represented by 8 coolies at $4·50 and one head man at $10 per month with food and quarters. Only one charge per day was smelted, as the crucible required repairing each time. The smelt was started by filling the previously heated crucible with live charcoal, with some coke on top; then the whole of the ore with the rest of the coke was piled on top and blowing with No. 1 and No. 2 blowers continued till the bulk of the charge had run down, say, in about 3½ hours; then the unburnt coke, with some partly smelted ore, was raked off, put aside, and the slag skimmed off. No. 3 blower was then placed in position and the matte blown with continuous stirring till it had got down to a dull red heat and fairly free from sulphur, more charcoal was then shovelled to raise the heat, and it usually was sufficient to burn off the remaining sulphur, leaving the metal molten ready for the final skimming. Should the preliminary calcining have been insufficient it would only be necessary to blow the metal right down again and add more charcoal. A few logs of dry wood were often thrown-in at this stage.

The blister copper thus produced usually assayed 90 to 95% metal, with about £20 worth of gold and silver per ton. A creditable performance all things considered. The method is probably Japanese. The slag averaged about 2% copper, with a trace of gold and 4 dwt. silver per ton. The yield, plus copper in the slag, in no way checked with the mine records of ore purchased. This was not unexpected, as an elastic item called 'sundries' in a statement of costs amounted to 200% on labour, food, fuel, and transport.

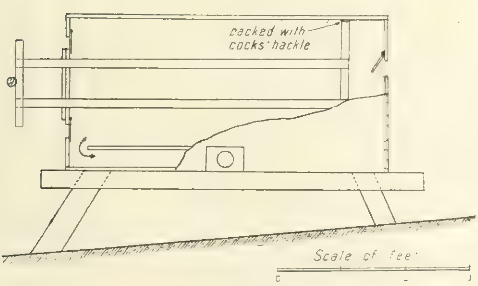
The cost of labour is high for China, owing to the scramble for coolies by the farmers from April to September. In the winter they will work for their food and lodging only, leaving in the spring when its suits their convenience. An attempt at importing labour proved an utter failure.

The country is badly infested with robbers, who are often in gangs of 80 to 100 or more, armed with modern rifles and sometimes in uniform. They have been known to hold-up a town of 5000 inhabitants. Besides these gangs there are numerous footpads, who are worse, for the large well organized bands are generally commanded by a hereditary brigand, who, if treated tactfully, will usually allow a foreigner to pass unmolested and even show him hospitality. Under present conditions it would seem impossible to make any improvement, as undoubtedly there exists an understanding between the robbers and the guardians of law and order.

most of the narcotics, does not require a constantly increased dose. A normal smoker takes three to four pipes, three times per day, which occupies 15 to 20 minutes each time, and that probably has been his quantity for years. As soon as he has finished he is ready for business with an unclouded intellect. Excess with opium in China is far rarer than with alcohol in England. *Sham-shu*, a spirit dis-



MANCHURIAN COPPER FURNACE.



Details of Blower.

The region is wonderfully fertile; wheat, millet, barley, maize, and soya beans grow luxuriantly with little cultivation. Opium is still smoked to a certain extent, a risky performance if the individual is unable to pay a substantial fine. Morphia as a substitute claims many victims. It is said locally that during the Russo-Japanese war, the troops used *ti*, or opium, for their horses on forced marches. The popular notion than an opium-smoker always becomes senseless after each pipe is as erroneous as to say that a man who drinks whisky is a drunkard. Opium, unlike

tilled from millet, is drunk at meals by most people, but intoxication is practically unknown.

The 'integrity of China' is often quoted in Europe, but one's impression is that 99% of the inhabitants know nothing and care less about it; but are intensely jealous of any interference in their own Provincial affairs.

The Output of Gold in the Transvaal during the last thirty years is given in the following table in pounds sterling:

	£		£
1884	10,096	1899	15,739,923
1885	6,010	1900	1,498,901
1886	34,710	1901	1,014,687
1887	169,401	1902	7,253,665
1888	967,416	1903	12,589,248
1889	1,490,068	1904	16,054,809
1890	1,870,000	1905	20,802,074
1891	2,938,900	1906	24,579,987
1892	4,698,000	1907	27,403,738
1893	5,649,000	1908	29,957,610
1894	7,809,000	1909	30,925,788
1895	8,578,000	1910	32,001,735
1896	8,598,000	1911	34,991,620
1897	11,476,000	1912	38,757,560
1898	16,044,135	1913	37,358,040
		Total for 30 years	£401,267,721

OIL-FUEL AND WASTE HEAT.

A Study of Thermal Efficiency in connection with the Utilization of Waste Heat of Reverberatory Furnaces for Steam-raising purposes.

By ARTHUR E. WILLIAMS.

IT is generally recognized that the hot gases escaping from a reverberatory furnace provide a fruitful source of power: boilers are installed in the flues leading from the large modern furnaces in order to turn this waste heat to account by generating steam for the power-house. As crude oil is being used increasingly as a fuel for reverberatory smelting in various parts of the world, the following notes on the combustion of oil, and the distribution and utilization of the heat in the products of combustion, may be of interest to those in charge of such plants, or to those engaged in their design.

I have considered the case of a modern reverberatory furnace 100 ft. long by 19 ft. wide, using crude oil of the following composition: C, 84·2%, H, 12·4%, O, 3·4%; having a calorific value, by bomb calorimeter, of 19,296 British Thermal Units (B.T.U.) per lb. The products of combustion from 1 lb. of this oil, including 0·5 lb. of steam for atomizing, and assuming the exact quantity of air required for complete combustion, would be: CO_2, 3·09 lb; H_2O, 1·618 lb; N, 10·71 lb; total 15·418 lb; and the quantity of air required for complete combustion 13·91 pounds.

In calculating the heat contents of the gases, I have used the formulæ for the mean specific heats of gases at high temperatures obtained by Holborn and Henning (*Annalen der Physik*, 1907, Vol. XXIII), and have calculated all heat contents from a temperature of 20° C. The heat contents of the gases with no excess air, at a temperature of 2000° C. (3632° F.) are as follows:

				B.T.U.
In CO_2	3·09	×	990·81	3,061·603
In H_2O	1·618	×	3192·57	5,165·578
In N	10·71	×	973·44	10,425·542
			Total	18,652·723

As the calorific value of the oil is 19,296 B.T.U., we see that the temperature of combustion, when only sufficient air is admitted for complete combustion, is slightly over 2000° C. (3632° F.). It is, of course, not practicable to work with only the bare quantity of air required for combustion, and some excess air must be admitted. In order to maintain the temperature of the flame, it is necessary to reduce the percentage of excess air to a minimum, compatible with the complete combustion of the fuel.

Taking the heat contents of the gases at 1800° C. (3272° F.) we get:

				B.T.U.
In CO_2	3·09	×	887·67	2,742·900
In H_2O	1·618	×	2880·27	4,660·277
In N	10·71	×	862·65	9,238·982
In 22·8% excess air (by diff.)	3·175	×	838·8	2,653·841
			Total	19,296·000

From this we see that with 22·8% excess air the theoretical temperature of the flame would be 1800° C. (3272° F.), and taking into consideration the cooling influences which act immediately on the flame this would probably give a smelting temperature of 1500° to 1600° C. (2732° F. to 2912° F.)

Let us now assume that the gases leave the furnace and go to the boilers at a temperature of 1200° C. (2192° F.) and leave the boilers at 400° C. (752° F.). The volume of the gases will be increased by gases given off from the charge, and by the infiltration of air into the furnace. It will probably not seriously affect the result if we consider all these gases as excess air, and we may estimate that, at the point of leaving the furnace, the dilution is equivalent to 50% excess air.

The heat contents of the gases at 1200° C. (2192° F.) will then be:

				B.T.U.
In CO_2........	3·09	×	563·202	1,740·2942
In H_2O.......	1·618	×	2119·95	3,430·0791
In N	10·71	×	547·92	5,868·2232
In 50% excess air	6·95	×	532·53	3,701·0835
			Total	14,739·68

The infiltration of air through boiler seatings is usually considerable, and we may expect to find that the gases going to the stack are diluted with, say, 100% excess air. We then have for the heat contents in the gases at 400° C. (752° F.):

				B.T.U.
In CO_2	3·09	×	156·726	484·28
In H_2O	1·618	×	1362·69	2,204·83
In N	10·71	×	166·05	1,778·39
In 100% excess air	13·91	×	161·37	2,244·66
			Total	6,712·16

Summarizing these results, we have:

	B.T.U.
Calorific Value of the Fuel	19,296
Heat Contents of the gases entering Boilers	14,740
Heat Contents of the gases leaving Boilers	6,712

and distribution of the heat as follows:

	B.T.U.	%
Abstracted in Furnace	4,556	23·61
Abstracted in Boilers	8,026	41·60
Sent to Stack	6,712	34·79
	19,296	100·00

In 'Metallurgical Calculations' Vol. III, Mr. J. W. Richards estimates that 13½% of the calorific value of the fuel is absorbed into the matte and slag, so that, on the above figures, 10% would represent the loss by radiation from the furnace. This would appear to be a reasonable allowance for a large modern furnace with thick walls and arch.

Of the 14,740 B.T.U. entering the boilers, about 7%, or say 1031 B.T.U., would be lost by radiation, and, as 6712 B.T.U. go to the stack, the quantity of heat accounted for in steam would be 6997 B.T.U., which would represent an evaporation of 7·24 lb. of steam per lb. of oil, from and at 212° F. The boiler efficiency would be about 47½ per cent.

The final temperature of the gases, 400° C. (752° F.), is too high for good work, and if, by a suitable arrangement of the boilers, this temperature is reduced to, say, 300° C. (572°F.), the evaporation would be increased by about 20% to 8·64 lb. per lb. of oil, and the boiler efficiency to about 56½%. In this case the quantity of heat turned to account in steam would be 8356 B.T.U., or a little over 43% of the calorific value of the oil.

By inserting 'economisers' in the flue behind the boilers, and thus reducing the temperature of the escaping gases to about 200° C. (392° F.) a further 6 to 7% of the calorific value of the fuel can be utilized.

It will thus be seen that, with a properly designed and operated waste-heat plant in connection with an oil-fired reverberatory, it should be possible to obtain in steam the equivalent of 50% of the calorific value of the oil.

From some figures kindly furnished to me a few years ago by Dr. L. D. Ricketts it appears that at Cananea, when using an oil with a calorific value of 18,750 B.T.U., the gross extraction of heat in the boilers, superheaters, and 'economisers' per lb. of oil, amounted to 9193 B.T.U., or 48½% of the calorific value of the oil, which agrees closely with my figures.

In the case under consideration, a useful extraction in the boilers, superheaters, and 'economisers' of 50% of the calorific value of the oil would give us 9648 B.T.U. in the steam, which is equivalent to an evaporation of 9·99 lb. of steam from and at 212° F. per lb. of oil burned. Assuming a working pressure of 200 lb. per sq. inch, feed water at 60° F., and a superheat of 150° F., the actual steam obtained per lb. of oil would be about 7·7 lb. Of this, 0·5 lb. will be required for atomizing the oil, leaving 7·2 lb. for the power-house.

High-class turbo-generators of fair size will give 1 k.w. for a consumption of about 16 lb. of steam per hour, but, to allow for pumps, losses, &c., we may take a figure of 20 lb. of steam per kilowatt-hour, in which case each lb. of oil burned in the furnace will provide 0·36 k.w. or 0·48 electrical horse-power.

In order to get the best results it is essential that the greatest care should be taken in the design and construction of the plant. All flues should be as short and straight as possible, and should be designed for the quantity of gases they will have to carry. The dimensions of the chimney stack should be calculated so as to give the required draught at the throat of the furnace, due allowance being made for the resistance of the boilers, 'economisers,' &c. If this is done, there is no reason why the boilers should not be fitted with the usual baffles as arranged in direct-fired boilers. A short by-pass stack should be provided, to take the gases from the furnace when for any reason the boiler plant has to be shut-down. If the boilers and generating plant are arranged in a sufficient number of units, so that there are always some standing as spares, it may be possible to do without the by-pass stack. All boilers should be fitted with auxiliary oil burners to enable steam to be maintained in the event of the furnace being shut-down. Boilers and generating plant should be divided into units of a reasonable size, so as to allow of elasticity in working. Finally, precautions should be taken to reduce to a minimum the infiltration of air into any part of the plant.

THE ORE DEPOSITS OF COBALT.

Local Geology. Vein Structure. Ore Occurrence. Origin. Production.

By J. MACKINTOSH BELL.

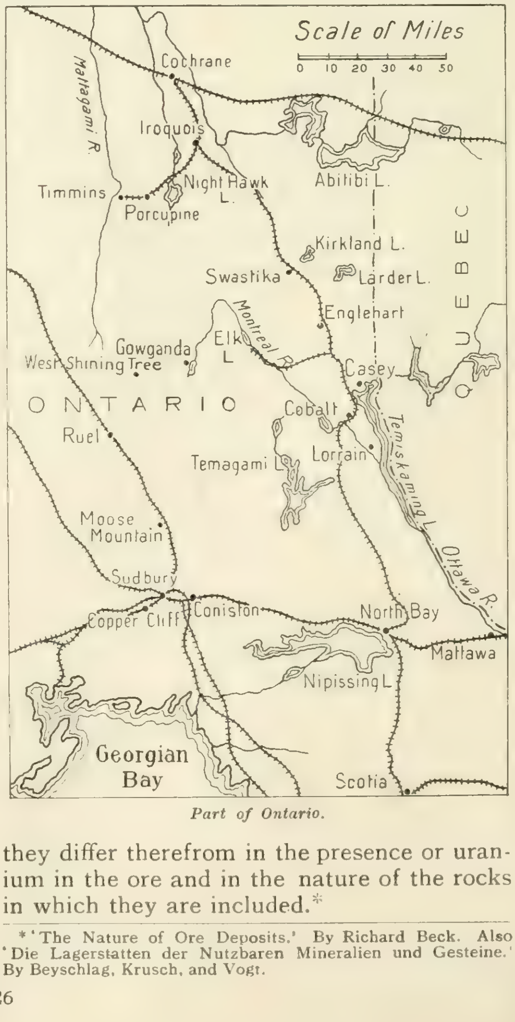
Introduction.—Ten years have elapsed since the first silver was found at Cobalt. Little did the discoverers, workmen, excavating a cutting in the construction of the Temiskaming & Northern Ontario Railway, realize that their unexpected find was destined to transform the wilderness roundabout into one of the richest and most prosperous mining camps in the world.

Cobalt is situated 260 miles north of Toronto in the heart of the pre-Cambrian highland of Ontario—a region of rolling hills, numerous lakes, and great forests. Travel from the railway was until recently effected by the Indian canoe, a convenient craft readily portaged from lake to lake, and past the rapids or falls of the many rivers. The growth of settlement in the wake of mineral development, however, has introduced more civilized methods. Roads are being constructed far and wide, especially to the north of Cobalt, where extensive tracts have been opened to an agricultural population.

Chief localities. — All of the working mines in the immediate vicinity of the town of Cobalt occur within a radius of 3 or 4 miles of the original discovery. Though it was at first difficult to arouse interest in the new district, the remarkable returns made with a small outlay within the first few years soon attracted so much public attention that the surrounding country was prospected with the object of locating other areas of similar character. None of the newer discoveries in the surrounding country have equalled in importance the original centre. The principal of these newer localities are South Lorrain, 18 miles southeast of Cobalt; Casey, 16 miles to the northeast; Elk Lake and Montreal River, 40 miles northwest; and Gowganda, 55 miles west-northwest. The geology and mineralogy of all these localities is similar to that of Cobalt, with local variations in each.

Similar deposits elsewhere.—About 500 miles west of Cobalt, near Fort William, in the Thunder Bay district, is a tract in which silver-bearing veins occur over a wide area, in rocks of the same general geological age as those of Cobalt. The mineralogical character of the veins of the two districts resemble each other in some respects, though in the Thunder Bay district the amount of gangue is generally greater, and the proportion of nickel, cobalt, and arsenic much less than at Cobalt. The genesis of the ores of Cobalt and those of Thunder Bay are apparently similar.

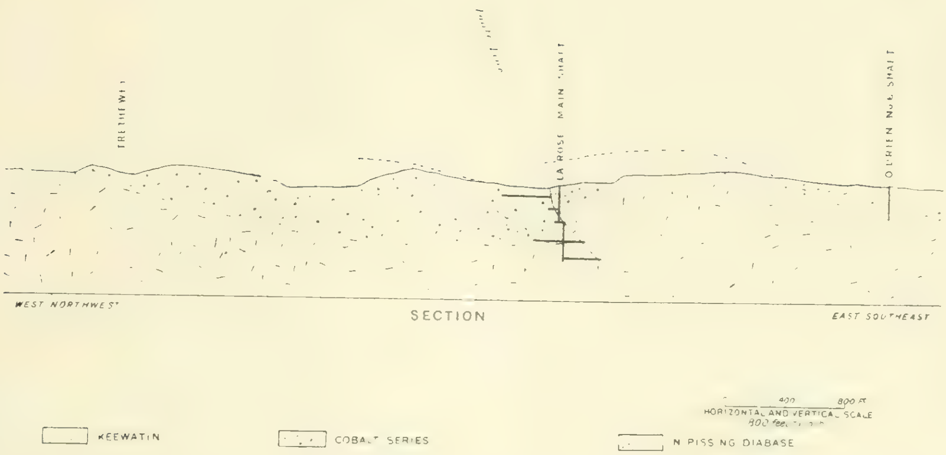
The Cobalt deposits bear a more marked resemblance to those of Joachimsthal in Austria and Annaberg in Saxony than they do to the Thunder Bay occurrences. In these two localities the structure of the veins and the mineral contents, both metallic and non-metallic, are remarkably like those of Cobalt, but



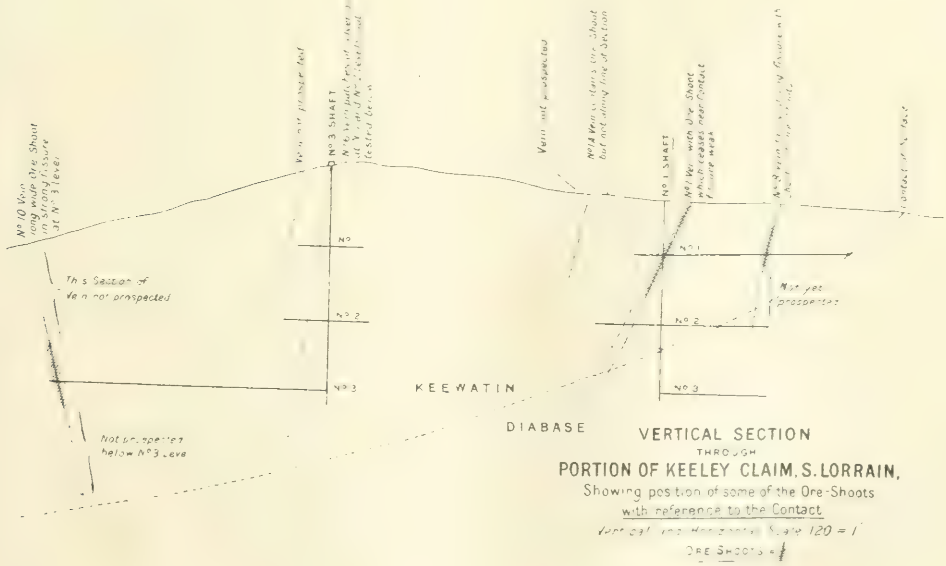
Part of Ontario.

they differ therefrom in the presence or uranium in the ore and in the nature of the rocks in which they are included.*

* 'The Nature of Ore Deposits.' By Richard Beck. Also 'Die Lagerstatten der Nutzbaren Mineralien und Gesteine.' By Beyschlag, Krusch, and Vogt.



SECTION THROUGH THREE MINES SHOWING THE RELATIONSHIP BETWEEN THE KEEWATIN SERIES AND THE DIABASE SILL. ALSO THE FAULT THAT RUNS THROUGH COBALT LAKE. FROM VOL. XIX, ONTARIO BUREAU OF MINES REPORT.



At Annaberg the strike of the veins was in general more regular than at Cobalt.

The veins of Schneeberg, which resemble those of Cobalt in the richness of their silver ores, are unlike the latter in other phases of their mineral content, more particularly in the higher proportion of bismuth.

Annaberg, Joachimsthal, and Schneeberg were important producers of silver and cobalt during the 15th and 16th centuries. Their rapid growth, and the ready returns made with only a small outlay of capital, is graphically like that of Cobalt. Annaberg and Joachimsthal have not been producers of any moment for some time, but as late as 1905, the Schneeberg field produced silver, cobalt, nickel, bismuth, arsenic, and uranium to the value of a little over £30,000.*

Similar in many ways to the Cobalt deposits are those of the Chalanches,† in France, which like the former occur in narrow irregular veins, with a variety of silver, cobalt, nickel, and arsenic minerals. The silver, however, is mainly in various compound forms and not native; and with the ore moreover is associated an appreciable quantity of gold, which occurs only to a slight extent in veins of the Cobalt district.

The famous silver veins of Kongsberg, and the less known occurrences of the island of Medveiji in the White Sea, resemble the deposits of Cobalt, in being narrow, in having commonly a calcite gangue, and in other respects. The fahlbands of Skutterud and Snarum in Norway, and the deposits of New Caledonia, apart from their cobalt content, bear little resemblance to those of the Cobalt district, either mineralogically or structurally.

General Geology.—The oldest rocks of the district consist of a great series known as Keewatin. These consist mainly of schists of igneous origin of a wide variety of petrological character and texture, but with them are included sedimentary rocks such as greywacke, slate, and jaspilite. Cutting the Keewatin rocks are gneisses and granites ordinarily known as Laurentian. Following the Laurentian are conglomerates and other fragmental rocks of the Temiskaming series. These are intruded in turn by lamprophyre and granite dikes. Next in succession are the rocks of the Cobalt series, consisting of conglomerate, slate, quartzite, and greywacke. These are ordinarily known as Huronian, but their exact connection with the classic Huronian area north of Lake Huron is as yet in doubt. Later than the Cobalt series are widespread intrusions of diabase, generally called the Nipissing diabase. All of the rocks so far described are pre-Cambrian. Above them all occur Silurian limestone, sandstone, and conglomerate which, however, have no connection with the ores of the district.

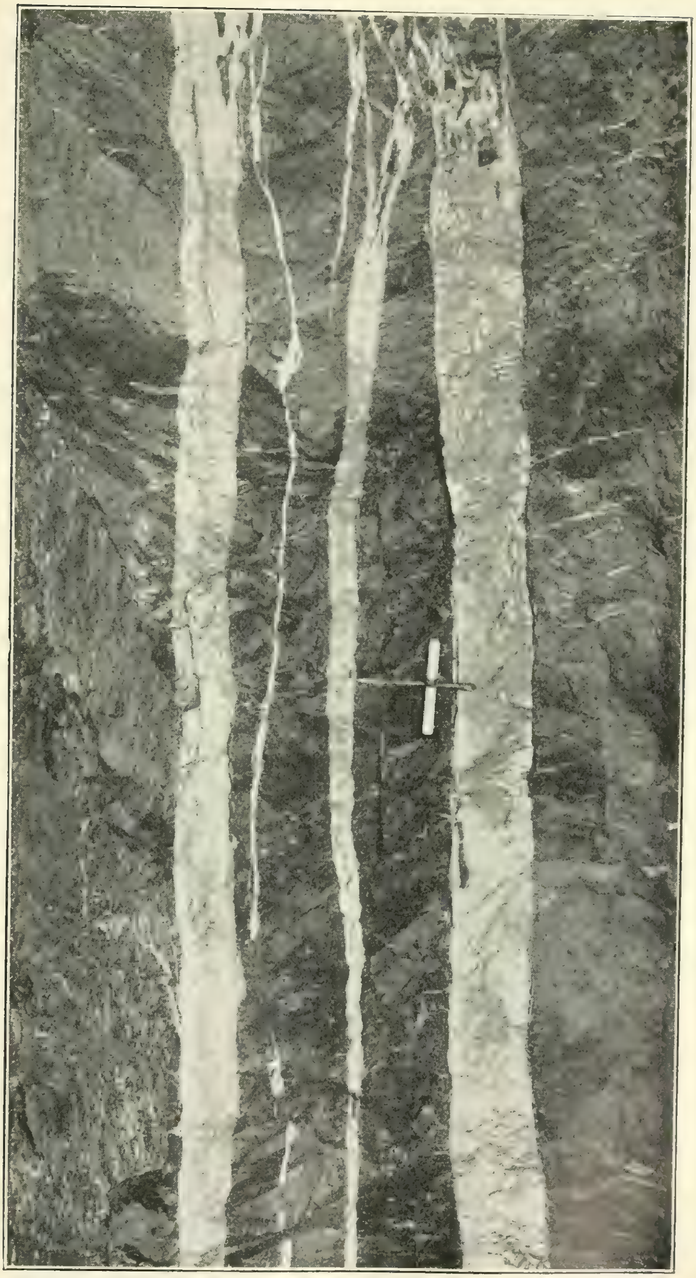
The structure of the Keewatin rocks is highly involved, and all are more or less foliated and metamorphosed. The Laurentian rocks are to some extent gneissoid, but the state of development of this feature varies greatly in different localities. The Temiskaming rocks are much sheared. The lamprophyre and granite which intrude them are metamorphosed but distinctly less so than the Laurentian. The rocks of the Cobalt series are much less disturbed than those that precede them; a marked unconformity occurring at their base, distinctly separating them from the older formations. In places, the conglomerate, slate, and greywacke, of which the series is composed, lie almost horizontally or are inclined at very gentle angles. The Nipissing diabase is in places altered, but generally only superficially.

As in all very old rocks, the pre-Cambrian strata have suffered marked regional disturbance—especially in two general directions—northwest - southeast and northeast - southwest. The former is more marked but the latter is more interesting, as it seems to have some general connection with the chief ore occurrences. Thus, the richest mines of the district lie in the vicinity of Cobalt lake, which occupies one of the most definite northeast southwest faults. As there seems evidence that movement took place along this line long subsequent to the formation of the orebodies, it is probable that the faulting was a recurrent phenomenon, beginning prior to the period of ore deposition and occurring at intervals thereafter. Minor faulting, both reverse and normal in character, is commonly seen in all of the mines. The veins themselves occupy fairly well defined fissures along which movement parallel to the trend of the fissure is apparent, or are situated along such short breaks as may perhaps more correctly be styled joint-planes.

The fissures and joints in which the veins occur and the material filling the veins themselves have a direct connection with the Nipissing diabase, which occurs generally in sills, but is also found in the form of dikes and bosses. At the time of the irruption of the diabase the intruded rocks were much shattered

* Report of the Ontario Bureau of Mines, Vol. XIX, Part 2, Page 250.

† 'The Mines of the Chalanches.' By T. A. Rickard. Trans. A.I.M.E. Vol. XXIV, Pp. 689–705.



Photograph by] *TYPICAL VEINS IN KERR LAKE MINE, COBALT.* [A. A. Cole and disturbed. These rocks were greatly heated at the time of the intrusion, and fractures resulted in them as well as the intrusives on shrinkage with cooling. In the various fractures formed in this way were deposited the minerals of which the veins are composed, as a result of the hydrothermal activity that followed the instrusion of the diabase. However, this deposition of vein material did not take place in one period only, as will be later explained.

The Deposits consist of extremely narrow and irregular veins, with little horizontal strength or longitudinal persistence. Most of them dip at angles approaching verticality or are actually vertical. As the rich ore is concentrated in small portions of the veins, so most of the veins occur close together in the several localities. A vein that perhaps has persisted for a few hundred feet may gradually (or even abruptly) cease altogether or become merely a thin soft selvage, carrying scarcely any vein material; while at the same time a fracture may branch from the main vein a short distance back from where it dies out, and change within a short distance into a well-defined vein. The strike of the latter may be widely divergent from the one of which it is a subsidiary. Quite commonly several parallel veins occur within a few feet of each other; one of these may carry ore for a short distance, and when this has become barren another may become enriched.

The veins vary in width from a fraction of an inch to more than two feet. The average is probably about four inches. One of the earliest veins discovered on the Nipissing property had a width of 14 inches. In length, the narrower veins seldom exceed a few hundreds of feet. The length of the La Rose main vein, on the La Rose and Right-of-way properties, is about 1000 ft; and a subsidiary vein has a length of 900 ft.* Some of the largest and widest veins in the district occur in the South Lorrain section. The Woods vein in this locality has been traced across several claims, and has a width in places of nearly two feet.

The non-metalliferous veins or portions of veins are often bordered by unaltered or but slightly altered country. The metalliferous veins—more especially when silver-bearing—are encased by country impregnated to a greater or less extent by metallic minerals, principally native silver.

Of the metallic minerals in the veins, native silver, smaltite, and niccolite are the most characteristic, but native bismuth and argentite are quite common. Galena, chalcopyrite, and pyrite occur most commonly where silver is absent. A larger number of other metallic minerals are found but they are more interesting as curiosities than quantitatively important. Calcite is the chief non-metallic mineral in the vein-filling; a pink dolomite is also common. Quartz is rare in Cobalt proper but is quite general in some of the outlying parts of the district, more especially South Lorrain. Apatite is seen in a few localities.*

Within the veins in places is found more or less country rock, sometimes in angular fragments showing that brecciation must have taken place during the formation of the vein-fissures.

Smaltite and niccolite were the first metallic minerals to be deposited in the veins and with them dolomite was associated. The veins containing these minerals were subsequently fractured, and in the cracks thus formed, were deposited calcite with native silver and argentite. Native bismuth seems generally† to have been deposited with the second group of minerals, but such has not always been the case. In the South Lorrain district it is apparently most common where the veins are non-argentiferous.

Cobalt and nickel bloom, especially the former, are common oxidation products, but are generally only surface occurrences, and as such aid prospecting, even when occurring without silver. Wire silver and ruby silver are found in places in the vein material and apparently are generally of secondary origin, due to descending solutions.

The ore is valuable for four metals, namely, silver, cobalt, nickel, and arsenic. Of these the value of the silver is naturally much greater than the others. However, the district is much the most important producer of cobalt in the world and the third greatest of nickel, being superseded only by Sudbury and New Caledonia. The output of arsenic is also considerable. Some of the ore carries also small amounts of mercury, gold, and copper.

The silver, as previously stated, is chiefly in native form, but with it is associated argentite, and, in much smaller quantities, other silver minerals.

Nearly all of the smaltite and niccolite carries some silver but only where the secondary deposition mentioned above has taken place in economic quantities; in other words, in

*Report of Bureau of Mines, Vol. XIX, Part 2, Page 124.

*It is quite common in the No. 8 vein of the Keeley mine, South Lorrain.

†Bureau of Mines Report, Vol. XIX, Part 2, Page 12.

the ore-shoots. No vein without silver in considerable amount is at present mined for its cobalt, nickel, or arsenic contents alone. These metals are obtained merely as by-products in the treatment of the substantially silver-bearing vein material, which thus becomes an ore of all the metals mentioned.

The ore may be divided into three varieties: high-grade, medium-grade, and milling-grade. These various grades differ materially according to the classification at the several mines. Within the ore-shoots the proportion of silver is often extremely rich, ranging up to 4000 oz. and even 6000 oz. per ton. Ore of 1000 oz. grade or upward may be classed as high-grade; that carrying from 150 to 1000 oz. as medium-grade; and that from 15 to 150 oz. per ton as suitable for milling. As yet it has not been found economical to treat vein-material carrying much less than 15 oz. per ton at the present price of silver. The high-grade and medium-grade ores are obtained almost entirely from the veins themselves, but the milling ore comes not only from the poorer silver-bearing patches in the veins, but from the mineralized country on either side thereof, where it may be 10 ft. or more in width. The fact that this rock on either side was silver-bearing to an economic extent was not fully recognized in the early days of Cobalt. To the appreciation of its value are due the large number of metallurgical plants that have been erected within comparatively recent years, and the steady increase in the output from the district.

The ore-shoots.—The factors that have controlled the existence and position of the ore-shoots are many, and even yet, though they have received careful geological study by many skilful investigators, are not entirely understood. However, certain features, now clearly demonstrated, are of value as guides to exploration.

There is no doubt that the origin of the veins is directly connected with the intrusion of the diabase, and that commercially important veins are only found relatively close to this rock. The contact of one series of rocks with another, more especially that of the diabase with either the rocks of the Cobalt series or the Keewatin, has an important economic bearing on the position of the ore-shoots. The veins which have been found to be productive to the greatest depth lie in the hanging wall of the diabase sill. At Cobalt itself, much of this wall has been removed by erosion and the greater number of veins are in the foot-wall or within the diabase.* The most persistent shoots have been found in the rocks of the Cobalt series. Those in both the Keewatin and diabase, though often exceedingly rich, have a less horizontal extension. Rich veins in any of these three rocks seldom continue productive after passing the contact. At South Lorrain, for example, veins in the Keewatin that are rich near the contact become barren when they pass into the diabase; on the other hand, veins occurring near-by that are rich in the diabase, in passing upward, become barren in the Keewatin. There are noteworthy exceptions to this rule of impoverishment at the contact, especially in veins occupying strong fissures.

The rocks of the Cobalt series are considered to have formed a more favourable locus of deposition for the ores than either the diabase or Keewatin owing to the fact that they fractured more readily. Even in the rocks of the Cobalt series, however, the ore-shoots are not long, seldom exceeding a few hundred feet. The deepest mines of the district, the Beaver and the Temiskaming, are in the Keewatin, which here forms the hanging wall of the diabase. In these mines again the richness of the ore-shoots is not so much a factor of the distance below the surface, as the relationship to the sill. In both mines silver has been obtained below 650 feet.

Though some of the widest and strongest veins are apparently valueless as silver producers, owing to the fact that the secondary phase of deposition has not taken place therein, such ore-shoots as do occur in the most persistent and strongest fissures ordinarily have the greatest vertical and horizontal extension.

Recognition of the above mentioned facts controlling the localization of ore has aided in the discovery of new ore-shoots. In the Temiskaming mine, where, as in all mines in the Keewatin, the ore-shoots are short, satisfactory results have attended the exploration of the numerous veins close to the contact of the diabase with the Keewatin. In the Keeley mine the scheme of exploration prepared by the writer was based upon the assumption that orebodies might be expected in the various veins near the contact even if the veins were quite barren relatively remote therefrom. The work outlined is not yet completed but three discoveries of rich ore have given evidence that the assumption is correct.

Effects of denudation.—In the long period of denudation supervening between the formation of the veins, following the intrusion

*Report Ontario Bureau of Mines, Vol. XIX, Part 2, Page 125.

of the diabase, and the deposition of the Niagara limestone, and again in the vast space of time following that event to the present, a large amount of the rich ore of Cobalt has been removed. Probably comparatively little, if any, of the rich ore reached the surface of the rocks in which it was enclosed when formed, but erosion since has no doubt removed the rocks above, as well as large portions of those in which the veins occur. This removal was obviously very great during the Glacial period, as is graphically proved by the discovery of fragments of rich ore, considerably displaced from their place of origin in the glacial débris. Where regional faulting has occurred in the ore-bearing sections of the district, the down-thrown blocks have been protected from denudation, and thus the orebodies within them have been preserved. To an event of this nature is due the preservation of the rich orebodies on the west side of the fault running through Cobalt lake.

Origin of the deposits.—In preceding paragraphs it has been indicated that the origin of the veins is connected with the Nipissing diabase. The fissures that the veins occupy are believed to be due partly to the movements which took place at the time of the intrusion of the diabase and partly to the contraction on cooling in the irruptive rock and in the intruded rock in the vicinity of the sill.

Subsequent to the formation of these cracks came the hydrothermal activity so characteristic of the dying phases of vulcanism. At first, as previously stated, these waters deposited such minerals as carried only traces of silver, then, following a certain amount of refracturing other waters brought the rich silver ores. The form in which the native silver entered is naturally conjectional. Miller,* after a suggestion of J. H. L. Vogt, for the Kongsberg veins, intimates that it may have come in the carbonate form, which is soluble in an excess of carbon dioxide owing to the association of the silver with calcite. Messrs. Palmer & Bastin have recently carried out a series of interesting experiments showing that sulphides and arsenides of copper and nickel precipitate metallic silver most efficiently from dilute sulphate solutions.† It is noteworthy that at Cobalt rich silver ore often occurs in association with niccolite.

Production.—Although the Cobalt silver district has only been known for a little over ten years, the output of the district is truly amazing. The gross production up to the end of 1913 was valued at over one hundred million dollars. Of this large amount more than half has been distributed in dividends—a record which can scarcely be equalled by any other mining district.

In 1912 the silver output from the ten principal mines was as follows:

Name of Mine.	Oz.
Nipissing	4,680,670
Coniagas	3,703,942
La Rose	2,920,344
Crown Reserve	2,714,765
McKinley - Darragh - Savage	2,694,560
Kerr Lake	1,895,309
Buffalo	1,890,150
Cobalt Townsite	1,505,396
Temiskaming	1,217,994
O'Brien	1,091,631

The total output of all the mines during the same period in cobalt, silver, and arsenic was valued at $17,805,397·00.

From the author's paper on the 'Mineral Industry of Canada' read before the Institution of Mining and Metallurgy on January 15 we extract the following statistical information:

The silver production of the Cobalt mines from the beginning of the camp in 1904 to the end of 1912 has been as follows:

	Oz.		Oz.
1904	206,875	1909	25,897,825
1905	2,451,356	1910	30,645,181
1906	5,401,766	1911	31,507,791
1907	10,023,311	1912	30,260,635
1908	19,437,875		

The total value for silver, arsenic, cobalt, and nickel up to the end of the year 1911 amounted to $65,379,871, and of this large amount no less than $30,198,004 had been distributed in dividends. This is exclusive of profits earned by privately-owned mines or close corporations, such as the O'Brien and the Drummond. If these were added, the total dividend would approximate $35,000,000. Of the silver output for 1912, over $9,324,000 was distributed in dividends, making the probable total dividends about $44,000,000, or about one-half the gross value.

The chief producers of the Cobalt district are the Nipissing, the Coniagas, the Crown Reserve, the McKinley-Darragh-Savage, the Buffalo, the Kerr Lake, the La Rose, the Cobalt Townsite, the Cobalt Lake, the O'Brien, the Temiskaming and Hudson's Bay, the Trethewey, the Temiskaming, and the Beaver, all in and around Cobalt itself; the Miller Lake-O'Brien in Gowganda, about 55 miles to the northwest of Cobalt; the Wettlauffer, about 18 miles southeast, and the Casey Cobalt, about 16 miles northeast.

*See Report Ontario Bureau of Mines, Vol. XIX, Part 2, Page 12.
†*Economic Geology*, March 1913, Page 140.

DISCUSSION

Ore.

The Editor:

Sir—Definitions of familiar words cannot be arbitrarily created, when formulated in the dictionaries, glossaries, and text-books. If the definitions are to be correct they must express the general conceptions held by competent users. In short, "use is the law of language." At the same time conceptions gradually change, and new meanings enter, while old ones are dropped. We have obsolete usage as well as that of the present day. In formulating a definition of such a word as 'ore' it is necessary to take all these matters into consideration. The same word, moreover, may be employed in markedly different meanings. Our dictionaries often separate their definitions into a number of successive paragraphs, each dealing with a single phase of the subject. We may look upon the word 'ore' in this way.

'Ore' is certainly collectively used for the great class of minerals which are and have been productive of the metals. We speak of a mineral as being an ore of iron, zinc, copper, etc., without reference to its amount in any particular mine. There is thus a class of minerals which are ores, shown to be such by experience. We may call this the purely scientific use. Among students of rocks who work with the microscope, there is a little group of early crystallizations in the igneous rocks often collectively called the 'ores.' The usage has no reference to actual mining, and the group contains some little minerals not productive of metals in any relations, as, for instance, apatite, titanite, and zircon, but as a whole it is characterized by certain well known ores, of which magnetite is chief.

In old days an ore was considered a compound of a metal with some substance called a mineralizer, which served to disguise and destroy the metal's ordinary properties. Soft, malleable, and sectile lead becomes brittle galena when combined with the mineralizer sulphur. Native copper in a rock was not considered ore, and the product of the mines was called 'copper-rock.' Native gold in quartz was not an ore, but 'gold-quartz.' Both these terms were formerly carefully observed. Miners in the western United States in the last century were at one time sharply divided into quartz-miners and placer-miners, each group filled with prejudices against the other. The old usage has practically disappeared, so that alike on Lake Superior and in California 'copper-rock' and 'gold-quartz' are respectively called 'ore.'

In its technical use, despite Mr. McCarthy's wish that the definition should be otherwise, there can be no question that the idea of profit enters into the meaning of ore. Dictionaries, works on mining and on the geology of ore-deposits, whether in English or German, contain the condition that, to be an ore, the metalliferous minerals must be mined at a profit. If an enterprise which was believed to be based on ore proved to be a failure, the conclusion would hold that its promoters *thought* they had ore, but really were mistaken—they only had minerals. We sometimes seek to emphasize this condition by the phrases 'pay-ore,' 'commercial ore,' etc., and the use of some such prefix might avoid all uncertainty as to whether the word was used in its technical sense or not.

It is correct, as Mr. McCarthy mentions, that non-metallic minerals when mined are sometimes described as ore, but it seems a great mistake to modify well-established usage to this extent. Coal is sometimes described as being in 'veins' (I do not refer to the asphaltic coals), but the usage does great violence to well grounded geological conceptions of a vein as later than both walls. It would seem to be rather a case of incorrect use than a sound reason to re-define 'vein.' In the same way 'ore' as applied to non-metallics does violence to well-established conceptions, and would seem to be over the line of correct usage.

I should be sorry to see the word 'ore' applied to coal, because even under Mr. McCarthy's definition that any substance which undergoes treatment after being mined should be ore, coal would be an unfortunate illustration, for the larger proportion of coal is burned crude, even if a small part of the total is coked. Why call it anything but coal?

Some years ago, after a review of all the easily accessible definitions, and after discussing the various connections in which the word 'ore' was employed, by metallurgists as well as miners, the following was proposed:

"In the scientific sense, an ore is a metalliferous mineral belonging to the group of those which have profitably yielded the metals to the miner, or metallurgist. In its technical sense an ore is a metalliferous mineral or an aggregate of metalliferous minerals, more or less mixed with gangue and capable of being, from the standpoint of the miner, won at a profit, or from the standpoint of the metallurgist, treated at a profit."*

Nevertheless, if it is advisable in the general estimation to change the time-honoured significances of being metalliferous or of being a source of profit, the change could be authoritatively introduced through discussion and by action of the Institution of Mining and Metallurgy in Great Britain and of the American Institute of Mining Engineers in the United States. The proposition is a fair one to lay before these organizations, and if it gained the support of the general membership, the mining and metallurgical fraternities would doubtless accept the decision; no less would the lexicographers.

J. F. Kemp.

New York, December 15.

*J. F. Kemp. 'What is an Ore?' Journal of the Canadian Mining Institute, March, 1909. *Mining and Scientific Press*, Vol. 98; 419—423. March 20, 1909.

The Editor:

Sir—The term 'ore' for a long time past has been used both professionally and popularly with so many different and vague meanings that today it has no precise significance unless specially defined by the user. Therefore I agree with all those who are convinced of the absolute necessity for a new and authoritative definition of the term, or alternately, for the coining of a new term, having a definite meaning, to take its place.

The thanks of the profession are due to you for taking up the matter, and the interesting discussion on this subject which has appeared in the columns of your valued Magazine affords overwhelming proof—if proof were needed—of the great differences of opinion as to what the term means among engineers of undoubted competence who have written on the subject.

I understand the term 'ore' should only be applied to the content of metalliferous masses, occurring abundantly in the earth, which contain one or more metals or metallic combinations that can certainly be extracted profitably on a commercial scale, having regard to all the conditions of time, place of occurrence, and others too numerous to embody in a general definition. But I doubt if any engineer has ever confined himself to the use of the term in only this, its strict sense. We are of necessity continually using the term to signify any occurrence of mineral aggregates, the commercially valuable contents of which might, or might not, ultimately be presumed to be capable of successful exploitation.

That the term was originally intended to be used only in relation to the heavy metals is proved by its generally accepted derivation: Anglo Saxon *ar (ora, or)* bronze, compare Icelandic *eir*, Latin *æs (æris)*, Old High German *er (ehern)*, etc., etc. This shows that originally it was not intended to include coal, sulphur, phosphate, limestone, etc., in the category of 'ore.'

I called attention to the need for a new definition of this term in 1901 in the discussion on J. D. Kendall's paper 'Ore in Sight.' (Trans. Inst. Mining & Metallurgy, Vol. 10, to which reference may usefully be made, especially to pages 167 *et seq.*, the subject being discussed by W. McDermott, E. P. Rathbone, A. G. Charleton, and myself).

Then, as now, many prominent members of the profession were satisfied with the vague and indefinite usage of the term, showing a deplorable lack of appreciation of the necessity for precision in technical terms, especially in those so commonly and frequently used. Again and again the exact meaning of a technical term in an Act of Parliament, a legal document, or a report, has become of the utmost importance, and many thousands of pounds have been dependent upon its exact interpretation, as, for instance, in Great Western Railway Co. *v* Carpalla Limited, when it took Mr. Justice Eve six days or more with an imposing array of counsel, learned and scientific men, technical experts, etc., to determine whether a deposit of china-clay was a mineral or not, within the meaning of the Railways Clauses Consolidation Act of 1845, to which case no doubt Dr. Hatch refers.

If we search our dictionaries, our textbooks, and our glossaries of technical terms we are no wiser; the differences in the meanings vary and change in form and colour with every movement of time and place, like particles of coloured glass seen through a kaleidoscope.

I enclose a few pages of definitions culled haphazard from works of reference, as they happened to be at hand, although I fear it may be too long to print, but it shows how great these variations are.

To illustrate this I may select four of them. Strangely enough, the definition that most nearly realizes my ideal is one of the oldest, taken from that splendid translation by Mr. and Mrs. H. C. Hoover of the work of Georgius Agricola *(De Re Metallica)*, which should be in every engineer's library :

"I now attach a second significance to these words for by them I mean to designate any mineral substances which the earth keeps hidden within her own deep receptacles."

Translators' Note : "The Latin *vena* or 'vein' is also used by the author for 'ore'; hence the descriptive warning as to its intended double use."

The following is from Dana's Manual :

"An ore is a mineral substance that yields by metallurgical treatment, a valuable metal, and especially when it profitably yields such a metal. . . . Further than this, where a native metal, or other valuable metallic mineral, is distributed intimately through the gangue, the mineral and gangue together are often called the ore of the metal it produces."

Von Cotta, in the translation from the second German edition by Frederick Prime, Jr., says :

"Under the general term 'ores' are comprehended all minerals and mineral aggregates, which from their metallic contents attract the attention of the miner. . . . The idea of the term 'ore' . . . cannot be well expressed in a more precise or scientific manner. There is not any particular class of minerals, or of rocks, corresponding to these terms. To them belong native metals, metallic oxides, metallic sulphides, and even metallic salts and their combinations ; but on the other hand not all metalliferous species of the mineral kingdom" [can be classed as ores and metalliferous deposits] "because many of these cannot, either from their nature, or the too small percentage of a metal they contain, proportionally to its worth, be worked with profit. No rock, for example, containing 5% of oxide of iron can be considered as an ore ; while on the other hand a vein of quartz, with but 1% of gold, would be regarded as a very rich and valuable metallic deposit ; so relative is the idea.

"It is even possible, and has already occurred, that a mineral, which for a long time was useless to the miner, and on this account was not considered as an ore, has, by means of new discoveries, been included in the category of ores. Blende, for example. . . . Far more striking are the cases of clay and cryolith from which aluminium is produced. . . .

"The number of minerals occurring as ores is very large ; of which many are very rare, or from other causes are, up to the present time, unimportant for practical purposes. It is impossible to draw a sharp line of demarcation between the important, and the unimportant ones ; since the unimportant may, through the progress of science, become important."

Chambers' Encyclopædia :

"Any mineral which is obtained by mining, and which contains a workable proportion of a metal, is called by miners an ore."

From the above, it would seem that the term originally meant a combination of one or more metals, or metalliferous minerals, occurring with a gangue of no commercial importance in a form from which the valuable metals, or some of them, could be profitably extracted.

The engineer is constantly investigating the occurrence of new orebodies, or old ones that have long been abandoned. In the initial stages of his investigation, and indeed sometimes for years thereafter, he is bound to use the term 'ore' and its derivatives and compounds, without at that time knowing whether ultimately the valuable contents can be profitably extracted or not. The successful exploitation of the metalliferous deposit may require an enormous capital expenditure, a new railway, or other special means of transport ; a river may have to be deflected or dammed, or tapped by an aqueduct, the mineral may have to be worked on a large scale, a new metallurgical process may have to be invented, tried, or modified, or new markets may have to be found for the product. Thus a thousand and one different complicated contingencies have to be worked out before the engineer can determine whether the metals can be profitably extracted or not, or whether the exploitation of the particular ore deposit under consideration will be profitable or unprofitable. Meanwhile, for this and other reasons, the engineer is debarred from correctly using this kaleidoscopic term or any of its derivatives and compounds, such as ore-treatment, ore deposit, orebody, ore-channels, etc., etc., or he risks using the term wrongly and has no suitable alternative available. Moreover, after these and all other material conditions have been determined, a drop in the price of metal or the discovery of a substitute again makes the use of the term a wrong one, so far as that use involves the significance of profitable extraction. That is the primary evil in the definition of the term as used today, and we must cut away all suggestion that the use of the term 'ore' implies that the material can be profitably treated on a commercial scale at that time and place if we wish to get a practicable working definition of the term.

The second difficulty arises from the limitation originally implied in the application of the term to aggregates of the heavy metals only. Through the progress of science, the lighter and rarer metals and earths are becoming of increasingly great commercial importance, so that what is 'ore' today is not 'ore' tomorrow, and the reverse. Hence I agree with those who hold that a new definition of the term is needed, which should be free from any implied reference to the heavy metals, and should be extended to include all true minerals of economic or commercial importance.

I hope I have at least helped to make good the claim which so many engineers will endorse, and which Mr. McCarthy initiated, that we surely need today a new definition of the term, or we must have a new term to use in its stead.

Here is where I ought to conclude, as I cannot offer a satisfactory definition of my own, but the following, keeping close to Agricola, though it inadequately expresses what I have in mind, may, for the purpose of discussion, serve as my suggested definition: "An 'ore' is any inorganic substance occurring in the earth from which any commercially valuable mineral or metallic combinations can be extracted."

In further explanation of the term we might add "without reference to the possibility or otherwise of their profitable extraction on a commercial scale under existing conditions," but the use of the term involves a reasonable presumption that under suitable conditions the valuable minerals or metallic combinations might be profitably realized.

W. H. TREWARTHA-JAMES.

London, December 31, 1913.

The Editor:

Sir—Any discussion of the proper definition of the word 'ore' should be subdivided under two topics, else confusion of thought is likely to be the result. We may thus discuss: (*a*) what is the present meaning of the word, as determined by the usage of the majority of those engaged in the practice and study of the art of mining; (*b*) what meaning should be assigned to the word, assuming that it is desirable to restrict its future use to a certain definite meaning, and that agreement is possible as to what that meaning should be.

Speaking on the first topic, I think it must be admitted that no exact definition of 'ore' according to present usage of the term is possible, for the ideas expressed by the term are not exact, but vague and shadowy. J. F. Kemp has made a careful study of the usage of the word, and has formulated a definition which involves the ideas that an ore contains a metal and that it can be worked at a profit. I venture to disagree with the beloved teacher who interested me in geology so thoroughly that the interest has persisted through years of work in other lines, because I feel sure that this definition does not fully satisfy him. No one would think of characterizing the deposits of potash salts in southern California or the *caliche* of Chile as ore, and yet they contain a metal, and are worked at a profit. I cannot even agree that profit is a criterion in distinguishing ore from what is not ore. Thus a vein of 'ore' worked at a small profit where it is 6 ft. wide may, if the wall-rock is hard and tough, be only a source of loss in working where the vein narrows to $1\frac{1}{2}$ ft. in width. It is obviously unreasonable and incorrect to so phrase the definition that certain material is ore when it occurs in a mass 6 ft. wide and not ore when the mass is only $1\frac{1}{2}$ ft. wide. Imagine the resident manager handing in a specimen to a geologist visiting the property, with the question:

"What is that?"

"That is lead ore."

"Yes, but what is this," handing him a second, identical with the first.

"That is lead ore also."

"No, you are wrong, that is waste."

Geologists are patient folk, and such an interview would probably not result in an assault and battery case, but certainly practically everyone would agree with the geologist that both specimens were lead ore. And yet, on the other hand, it is equally unquestionable that the idea that ore is a substance which yields a profit is inextricably bound up with the other idea which the word conveys in general usage. The trouble is that usage is not precise and exact, but vague and slipshod.

A similar looseness prevails as to the use of the noun 'mineral' and the verb to which it has given rise. Suppose the case of a vein discovered in a cross-cut, paralleling the main vein, but containing only gangue minerals at the point where it is found. Upon driving along the vein it is found to change, the sulphides characteristic of the ore in the main vein appearing and increasing in amount until the vein-matter is apparently identical with the ore of the main vein. Most observers would describe this by saying that the vein 'became well mineralized' and the phrase would be generally understood, yet as a matter of fact it does not convey any exact meaning to one who is not familiar with the local circumstances. And if this 'well mineralized vein' differs from the other in the slight but important fact that it does not contain the gold which makes the other profitable the vein-material cannot be called ore, for, even if it does not contain gold, it is certainly not gold ore. Still it may contain a small amount of copper and at a later date and under more favourable circumstances, such as the building of a railway, or the discovery of coking-coal near by, it may be possible to mine and smelt it at profit. Here apparently is a case open to my objection; a substance that was not ore has become ore without itself undergoing any change. What I hope I have brought out is that ore, in its present usage, is not a precise word. A circle is always a circle, at all times and all places; it may be precisely defined in words or by the use of mathematical formulæ. Ore is a vague word involving concepts that hinge upon the characteristics of the substance itself, and also upon matters entirely extraneous. You cannot write a mathematical equation to define the curved path of a golf-ball as it flies under the influence of the force of the stroke, gravitation, wind (perhaps varying in velocity and direction at different points in the path), and irregularities in the shape of the ball and its speed of rotation on its axis. Neither, I believe, is it possible to frame any precise definition of the word 'ore' as at present used.

Speaking to the second topic, there can be little dispute as to the advantage that would accrue if a precise meaning would be assigned to the word. The question is, what shall that meaning be and how shall the use of the word be restricted to that meaning? You, sir, have urged that the idea of profit be rigidly insisted upon and that material otherwise resembling ore but of too low grade to yield a profit is simply 'waste.' I have already referred to this and others have opposed the suggestion also, so I shall say no more than that such a procedure gets us out of one difficulty only to fall into another, and the net result seems not worth the effort required to bring about the change. After having formulated several definitions only to reject them after further study, I have arrived at a point where, to paraphrase Descartes, I only know that I object to all the proposed definitions. Perhaps it would be feasible to introduce a new word to which a precise definition can be assigned.

THOMAS T. READ.

New York, December 20.

[This discussion has proved so interesting, and useful, that we are loth to close it. Further letters are invited.—EDITOR.]

Graphite as a Precipitant of Gold from Cyanide Solution.

The Editor:

Sir—In your editorial on the Prestea mine in the November issue you remark:

"The recent high residue, higher than 6s., probably as high as 9s. per ton, is due not to an inherent refractoriness in the ore itself, but to the graphitic schist that breaks away from the hanging wall, the graphite re-precipitating the gold from the cyanide solution."

The opinions of metallurgists as to the precipitating action of graphite on cyanide solutions differ. Morris Green, in a recent paper read before the Institution of Mining and Metallurgy on the 'Effect of Charcoal on Gold-bearing Solutions,' states that graphite is not a precipitant of gold, and that charcoal precipitates gold from cyanide solutions owing to the occluded reducing CO gas. H. K. Picard not only confirms this view but contends that the presence of graphite during cyaniding did good rather than harm. No suggestion is made, however, of the beneficial action.

It seems to me that the contention that the presence of graphite is detrimental to cyaniding is not without foundation. The Lancefield mine, in Western Australia, with ore of a high gold-content, has so far proved unremunerative in treatment, owing to the presence of graphite and arsenic. Possibly there is some special difficulty in the combination of the two elements. At Deloro, Ontario, arsenical gold ore was profitably treated, being amalgamated, bromo-cyanided, and the concentrate burnt for arsenic. Arsenic is also a feature in the ores of Cobalt, yet the Nipissing cyanide plant successfully treats silver ores associated with smaltite and cobaltite. Graphite, then, seems the disturbing element.

India has had experience with graphite in the cyanidation of gold ores, notably at Dharwar. R. H. Kendall, metallurgist at the Dharwar Reefs, now with the Mysore company, writes as follows:

"There can be no doubt that the difficulty of cyaniding the Dharwar ore was due to graphite; at any rate its presence caused the cyanidation of either the sand or slime in bulk to be a failure. My mission to Dharwar Reefs was to discover a means of extracting a payable quantity of gold from the tailing. I discovered that a fair amount of free fine gold (spangles or plates) existed in the tailing, and this I recovered by the use of blankets, as it would not amalgamate. A very large portion existed, combined with pyrite; this I recovered by vanner and canvas strakes. The blanket concentrate containing free gold was treated in an amalgamating pan with mercury and cyanide, and yielded a good extraction by this means, amalgam and dissolved gold which did not re-precipitate. The vanner and strakes concentrate was ground in a wheeler pan and cyanided by agitation in a Pachuca agitator. These also yielded a high extraction. The vanner tailing was separated into clean sand and slime, the former yielding a few grains (4 to 6) only per ton, and the latter was untreatable. About 66% of the tailing-value was recovered by these means. The presence of fine flakes of free gold in the tailing, and the difficulty I found to get them to amalgamate led me to assume that they were coated with a graphitic film."

This is an interesting experience, if not altogether convincing in its deduction. Graphite at Dharwar was a marked feature of ore treatment, detrimental to amalgamation and destructive of successful cyanide treatment.

My interest in the matter of graphitic interference arises from the presumed presence of this element in a smaller quantity in an ore also being treated in South India. The gold, mostly fine, is light in colour, and although tube-milled, does not amalgamate readily, although, after passing several times over the plates in the tube-mill circuit, from 50 to 60% is recovered by amalgamation. A dark oily scum collects at the surface in the vat, shows at the edge of the riffles on the plates, and coats the collected amalgam. The plates become discoloured rapidly, at times ten minutes sufficing to coat the plate a blue-black. Portions of a graphite crucible thrown into the discharge-end of the tube-mill rapidly produced a similar effect, again suggesting the presence of graphite in the ore.

The cyanide extraction, by filtering, is about 85%, giving from 90 to 92% total extraction by assay. The Pachuca-washed sample runs comparatively high, hence suggesting precipitation by graphite. The washing in the filter, however, extracts a large portion of this residual gold. Hence the interference by graphite is negligible, if, indeed, the oily scum referred to is indeed graphite. To determine roughly the precipitating power of graphite on our solution we carried out the following test:

Ten grams of plumbago crucible were agitated in 2 litres of working solution for 6 hours.

	% KCN	% CaO	Au Dwt.
Before agitation ...	0·026	0·0058	3·1
After agitation......	0·026	0·0046	2·44

This experiment indicates a precipitation of 0·66 dwt. gold, with no cyanide and little lime consumption. This again is not conclusive. Occluded CO might have been the reducing agent, as the pot used had been utilized for fusion. Such, however, is scarcely possible. Southern India, therefore, does not look favourably on graphite in the beneficiation of gold ore.

Why "re-precipitation"? In the treatment of the ore after solution, the first precipitation is suggested by graphite. The gold is precipitated. Should solution again occur, then the zinc might be said to re-precipitate. All writers seem to use this apparently unwarranted term. How does it appear to you, Mr. Editor?

H. E. WEST.

South India, December 20.

Hydrocyanic Acid as a Solvent for Gold.

The Editor:

Sir—Much has been heard recently of the use of a solution of hydrocyanic acid, HCN, as a solvent for gold, and several people have suggested to me that it might be used commercially. I therefore made some experiments as to its volatility and its action on gold, and I give herewith my results.

For my experiments I prepared a solution of HCN by the action of concentrated sulphuric acid on potassium ferro-cyanide, bubbling the gas evolved through tap water. The solution was kept in a glass-stoppered bottle.

The curve on the next page shows the loss of HCN that was found to take place, on leaving a portion to stand, undisturbed, in an open dish, in an average atmospheric temperature of 22° C., the loss being complete in 16½ hours. All tests for HCN were made by adding the solution to an excess of potassium hydrate and titrating with silver nitrate, using potassium iodide as an indicator. The results are expressed in terms of KCN.

Experiments were made comparing the solubility of gold leaf floated on solutions of HCN and KCN; Table I gives the result.

In other experiments comparison was made of the solubility of gold leaf in a solution of of KCN. (1) 'Neutralized' with sulphuric acid, using phenolphthalein as indicator. (2) Acidified with double the quantity of sulphuric acid required for (1). The results are given in Table II.

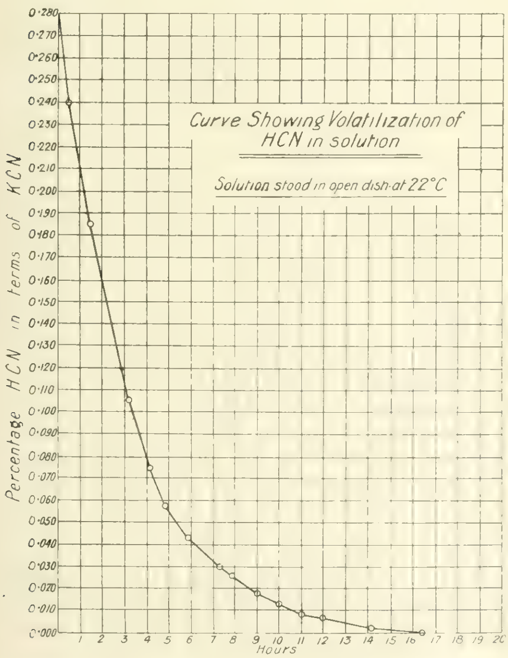
TABLE I.

HCN in terms of KCN.	Time.	KCN.	Time required to dissolve gold leaf.
0 316%	No perceptible difference	0·316%	3·5 minutes
0·030%	in leaf after 20 hours	0·030%	13·5 minutes

TABLE II.

No.	Time required to dissolve gold leaf.	Remarks.
(1)	35 minutes	Strength of KCN before
(2)	No perceptible dissolution in 20 hours	adding acid 0·66%

It would appear from the table that gold was soluble in (1) when no alkaline cyanide was present; but such is not the case, as on titrating the 'neutralized' solution with silver nitrate I found KCN still existed to the extent of 0·016%, although showing no alkaline reaction while existing side by side with a much greater quantity of HCN. This solution, on standing for some time, gradually became alkaline, due to the volatilization of the HCN, leaving the KCN to assert itself.



Experiment (2) showed no cyanide present as alkaline cyanide.

The next experiments were intended to show the solubility of gold in an ore: (1) In solution of KCN, the proportion of gold dissolved was 66·4%; (2) In solution of KCN 'neutralized' with sulphuric acid, using phenolphthalein as indicator, the proportion of gold dissolved was 30·2%; (3) In solution of HCN, equivalent to 0·25% KCN, no gold was dissolved.

The ore was ground to pass 150-mesh and agitated for 10 hours in an experimental Pachuca vat; the original strength of solution in each case (in terms of KCN) was 0·25%; the content of the ore was 13·6 dwt.

The above experiments were carried out in duplicate; all due care and common sense were used as to temperatures, sameness of gold leaf, similarity of ore-treatment conditions, etc.

These results show that gold is not soluble in HCN solution. I take it that we might arrive at the same conclusion from theoretical considerations, for the H ion would cause precipitation of any gold dissolved by the CN ion, and thus a state of equilibrium would be produced, showing an economic result, if I may use the term, of no gold dissolved.

H. T. LAMBERT.

Barberton, Nov. 15.

Sulphur in New Zealand.—In our issue of April last year we gave some particulars of the sulphur deposits on White island, off the coast of the north island of New Zealand. These deposits are found in the crater of an old volcano. The latest report shows that production should have commenced by now. Since the middle of last year, the erection of the plant and buildings has been actively conducted. The sulphur is being continuously deposited from the fumaroles, and special means have been devised for collecting it. The old cut, which was abandoned by previous owners, has been proved to contain many thousands of tons of high-grade sulphur.

QUOTATIONS

of leading mining shares on the London Market.
Shares are £1 par value except where otherwise noted.
Quotations are given in shillings.

GOLD, SILVER, DIAMONDS:	Feb. 1 1913	Jan. 2 1914	Feb. 2 1914
RAND:			
Bantjes	26	14	16
Brakpan	87	48	60
Central Mining (£12)	207	152	175
Cinderella	21	5	7
City & Suburban (£4)	45	47	43
City Deep	66	52	66
Consolidated Gold Fields	61	42	54
Consolidated Langlaagte	30	30	34
Consolidated Main Reef	23	18	20
Crown Mines (10s.)	145	125	133
Durban Roodepoort	20	16	20
D. Roodepoort Deep	22	17	21
East Rand Proprietary	59	40	45
Ferreira Deep	67	47	50
Geduld	23	21	24
Geldenhuis Deep	27	23	27
Heriot	77	52	53
Jupiter	12	5	7
Kleinfontein	22	21	26
Knight Central	13	7	10
Knight's Deep	45	30	33
Langlaagte Estates	33	18	22
Luipaard's Vlei	10	9	10
Main Reef West	20	6	12
Meyer & Charlton	108	107	115
Modderfontein B	77	82	89
Modderfontein, New (£4)	256	232	256
Nourse	38	31	36
Primrose	42	33	36
Rand Mines (5s.)	139	112	130
Randfontein Central	26	21	27
Robinson (£5)	70	53	57
Robinson Deep	42	30	31
Rose Deep	65	47	50
Simmer & Jack	20	11	13
Simmer Deep	2	2	3
Springs	16	11	15
Van Ryn	78	71	72
Van Ryn Deep	24	35	41
Village Deep	44	35	40
Village Main Reef	53	37	42
Witwatersrand (Knight's)	65	72	76
Witwatersrand Deep	55	57	61
Wolhuter	18	12	15
RHODESIA:			
Cam & Motor	37	27	29
Chartered	27	18	22
Eileen Alannah	13	12	16
Eldorado	32	13	19
Enterprise	17	13	16
Falcon	27	15	17
Giant	22	15	18
Globe & Phœnix (5s.)	32	26	36
Lonely Reef	53	43	47
Shamva	62	36	46
Wanderer (5s.)	1	1	2
Willoughby's (10s.)	12	7	10
OTHERS IN SOUTH AFRICA:			
De Beers (£2 10s.)	420	353	385
Glynn's Lydenburg	23	12	16
Jagersfontein	146	105	112
Premier Diamond (2s. 6d.)	237	190	205
Sheba (5s.)	5	5	6
Transvaal Gold Mining Estates	55	48	51
WEST AFRICA:			
Abbontiakoon (10s.)	7	7	7
Abosso	21	17	17
Ashanti (4s.)	21	17	19
Broomassie (10s.)	6	6	5
Prestea Block A	19	14	15
Taquah	17	17	16
WEST AUSTRALIA:			
Associated Gold Mines	8	8	9
Associated Northern Blocks	16	10	9
Bullfinch	15	10	10
Golden Horse-Shoe (£5)	38	52	55
Great Boulder Proprietary (2s.)	12	13	15
Great Boulder Perseverance	3	2	2
Great Fingall	10	14	15
Ivanhoe (£5)	67	58	56
Kalgurli	41	37	38
Sons of Gwalia	21	22	23
Yuanmi	10	5	5

	Feb. 1 1913	Jan. 2 1914	Feb. 2 1914
OTHERS IN AUSTRALASIA:			
Blackwater	23	20	19
Consolidated Gold Fields of N.Z.	13	14	18
Mount Boppy	20	16	13
Mount Morgan	63	63	65
Progress	6	9	12
Talisman	40	42	42
Tasmania Gold (10s.)	1	½	½
Waihi	32	52	53
Waihi Grand Junction	22	25	27
AMERICA:			
Alaska Treadwell (£5)	175	155	160
Buena Tierra	20	16	16
Butters Salvador	50	35	35
Camp Bird	20	11	13
Casey Cobalt	55	41	40
Cobalt Town Site	76	50	55
El Oro	18	13	15
Esperanza	35	19	21
Granville	14	10	10
Mexico Mines of El Oro	135	95	102
Oroville Dredging	7	15	14
St. John del Rey	16	15	15
Santa Gertrudis	26	16	18
Stratton's Independence (2s. 6d.	2	½	½
Tomboy	27	25	26
RUSSIA:			
Lena Goldfields	61	37	48
Orsk Priority	17	6	7
Siberian Proprietary	10	2	5
INDIA:			
Champion Reef (2s. 6d.)	12	10	10
Mysore (10s.)	107	97	98
Nundydroog (10s.)	22	27	26
Ooregum (10s.)	18	21	21
COPPER:			
Anaconda (£5)	155	145	156
Arizona (5s.)	41	37	40
Cape Copper (£2)	125	95	90
Chillagoe (10s.)	2	1	2
Cordoba (5s.)	7	7	6
Great Cobar (£5)	86	16	13
Great Fitzroy (5s.)	1	3	2
Hampden Cloncurry	47	34	35
Kyshtim	60	60	62
Messina (5s.)	21	30	30
Mount Elliott (£5)	157	68	82
Mount Lyell	23	23	25
Rio Tinto (£5)	1450	1370	1470
Sissert	25	21	30
South American Copper (2s.)	32	28	27
Spassky	81	53	61
Tanalyk	50	60	63
Tanganyika	53	37	45
Tharsis (£2)	125	137	135
Whim Well	22	10	8
LEAD-ZINC:			
BROKEN HILL:			
Amalgamated Zinc	37	27	30
British Broken Hill	46	34	44
Broken Hill Proprietary (8s.)	41	35	41
Broken Hill Block 10 (£10)	36	31	41
Broken Hill Block 14 (25s.)	9	7	8
Broken Hill North	44	51	56
Broken Hill South	151	143	172
Sulphide Corporation (15s.)	26	22	26
Zinc Corporation (10s.)	16	17	21
RUSSIA:			
Russo-Asiatic	—	72	107
TIN:			
NIGERIA:			
Abu (5s.)	—	10	12
Bisichi	23	14	19
Jos (5s.)	8	7	8
Kaduna (5s.)	30	15	17
Naraguta	30	30	31
Nigerian Tin	28	18	18
N. Nigeria Bauchi (10s.)	6	3	5
Rayfield	20	10	11
Ropp	130	122	131
OTHER COUNTRIES:			
Aramayo Francke	32	33	35
Briseis	11	6	7
Cornwall Tailings	35	17	17
Dolcoath	24	16	17
Geevor (10s.)	17	10	7
Gopeng	35	27	28
Mawchi	26	20	27
Pahang Consolidated (5s.)	11	10	12
Renong Dredging	—	40	45
Rooiberg	35	26	28
Tekka	75	60	60
Tronoh	87	35	42

PRÉCIS OF TECHNOLOGY

Rock-Drill Economics.—At the October meeting of the South African Institution of Engineers, E. G. Izod and E. J. Laschinger read a paper entitled 'Air Consumption and Maintenance Costs of Rock-Drills.' Of all the methods of transmission of power, that of compressed air is most carelessly and wastefully employed. A large proportion of this power used by the Central Mining group is bought from a central producing company, the Rand Mines Power Supply Co., and it is obvious that care in its use will reduce the bill. [Brief reference was made to this paper in an Editorial last month.]

The air is sold by meter at a pressure of about 100 lb. per sq. in. A unit is about 440 cu. ft. of air at the Rand atmospheric pressure, namely, 12·1 lb. weighed at 60° F. This unit represents 641 watt-hours, which is the energy available by its isothermal expansion from 100 lb. to 0 lb. gauge pressure. In the experiments on air consumption the arbitrary unit adopted is a 3¼ in. rock-drill shift, that is the consumption of air of a 3¼ in. rock-drill performing the average work of an eight-hour shift. The consumption of air by other plant such as winches and pumps is carefully noted and is expressed in terms of the consumption unit. A 3¼ in. rock-drill on stoping work is found to use 80 air-power units per shift, equivalent to 35,200 cu. ft. of free Rand air. The same machine when used on development work consumes twice this amount of air. A useful diagram is obtained by plotting the average air units per 3¼ in. rock-drill shift per month as ordinates, and the ratio of development shifts to total shifts as abscissæ. A comparison of this diagram for successive months reveals any existing excessive air consumption. By attention to this point the Central Mining group reduced their air consumption per drill shift in 1912 from 163 units in January to 138 units in November and December. This includes rock-drills, pumps, and winches. The authors point out that paying for air by meter leads to the careful use of it, and that to use compressed air for ventilating underground is excessively expensive and should give place to better methods.

Exhaustive experiments were made at the Village Main Reef to gauge the efficiency of rock-drills, and the point of greatest importance was found to be the fit of the piston in the cylinder. A slack fit was found to result in higher air consumption. The accompanying table is compiled from a series of experiments with the standard Ingersoll drill.

EXPERIMENTS WITH ROCK-DRILL HAVING A CYLINDER WITH 3·183 INCH BORE

Gauge Pressure.	70 lb.		90 lb.	
Piston, diam. in inches	3·177	3·157	3·177	3·157
Slackness in inches	0·006	0·026	0·006	0·026
Strokes per minute	236	235	250	262
Lb. of air per minute	6·9	9·4	10·2	12·8
Lb. of air per cycle (1 double stroke)	0·0292	0·0400	0·0408	0·0490
Cu. ft. of free air per minute at 68° F. and 12·2 lb. absolute	112	152	165	207

Investigations were made into the cost of maintenance and upkeep of rock-drills. Including new and spare parts, hoses and workshop costs (including white and native labour) it was found that each rock-drill cost 175s. per 52 drill-shifts (one month's full work). A contract system was introduced whereby the upkeep cost was lowered from 175s. as above to 113s. The contract is generally made with the rock-drill fitter at a fixed price per 52 drill-shifts. An account is made each month, the contractor being credited with an amount corresponding with the drill shifts worked. He is debited with the cost of spare parts, labour, etc. From the balance between credit and debit, the contractor is paid his guaranteed wage, leaving a balance of which the mine and contractor take half each. The contracts stipulate that rock-drills must be brought to the workshops after working not more than 156 shifts, and in the shops they are always thoroughly overhauled. A stock of pistons of various sizes rising by $\frac{1}{32}$ in. is carried, and there are standard reamers to suit, so that each time the cylinders need reamering out, it is done, and a standard piston is at hand to fit the larger bore accurately. It is advisable to test the drills before they go underground, not only to see that they act well, but that their air consumption is satisfactory. The authors consider that it should be possible to keep rock-drills in first-class order, for from 90s. to 95s. per 52 drill-shifts. HUMPHREY M. MORGANS.

Hall's Sulphur Process.—In our issue of August last we gave some particulars of the process, invented by W. A. Hall, having for its object the production of elemental sulphur instead of sulphurous acid in furnaces used for roasting sulphide ores. The advantages of such a process would be great, as by its means the atmosphere would not be polluted with noxious gas and the smelter would obtain a useful product easily shipped. At the time of writing the article, the details of the process were not available. We therefore give here a précis of the English patents, since published, numbered 20,757, 20,759, and 20,760 of 1912. In the first of these, Mr. Hall describes his method for producing sulphuretted hydrogen from pyrite. He heats the pyrite with a reducing flame obtained from producer gas, and a limited supply of air, and admits at the same time steam. The pyrite is agitated in any suitable manner. The result is that the sulphur of the pyrite combines with the hydrogen provided by the steam, to form sulphuretted hydrogen. The claim is as follows: "A process for the production of sulphuretted hydrogen from iron pyrite consisting in subjecting the pyrite while agitating the same to the combined action of a reducing flame, which decomposes it without producing any appreciable amount of oxidation, and steam intended to furnish hydrogen to the sulphur and oxygen to the iron." Patent 20,759 describes a furnace of the multiple-hearth type suitable for the process. Patent 20,760 deals with the production of sulphur from sulphuretted hydrogen by the reaction therewith of sulphurous acid, according to the well known equation $H_2S + SO_2 = 3\,S + 2\,H_2O$. The inventor states that this reaction is not usually complete, as much of the sulphur is transformed into thionic acids. To obviate this loss of sulphur, he brings the mixture of the two gases into contact with highly heated sulphur vapour. He finds that a small admixture of steam greatly facilitates the reaction.

In patent 26,595, Mr. Hall describes the process for producing elemental sulphur in one operation from sulphides. He uses any mechanical roasting furnace with superposed shelves and heats it internally by a mixture of producer gas and air, the amount of air being so regulated that the flame produced is of sufficiently reducing character to combine with free oxygen. Steam is passed in through inlets between the shelves, and preferably in larger quantity between the lower shelves. When the furnace is sufficiently heated, the stream of sulphide is admitted, with as little air as possible. By maintaining an internal pressure in the furnace, air is prevented from entering. The products of combustion pass out through the top into a long discharge pipe, in which they are cooled by several hundred degrees. As they are discharged, they contain yellow sulphur vapour, with no appreciable sulphurous acid. They are sent to washers, where the sulphur is caught in water. Steam is admitted in the course of the discharge pipe to prevent the formation of carbonyl sulphide, COS.

Secondary Chalcocite.—In *Economic Geology* for December, Austin F. Rogers discusses the formation of chalcocite as a primary or as a secondary mineral, especially in connection with its existence as a product of secondary enrichment. Secondary enrichment is at present assumed to be effected by the descent of soluble sulphates derived from the oxidation of the upper zones. Mr. Rogers introduces a new suggestion, namely, that the action may in some cases have been caused by hot ascending solutions. This idea was originated by microscopical and geological studies at a mine in Plumas county, California. Here the bornite, chalcopyrite, and chalcocite are disseminated through a norite-diorite rock in such a way as to indicate that they were formed at the end of the magmatic period by pneumatolytic agents. Microscopic examination showed the replacement of the silicates by these minerals. The non-metallic minerals were perfectly fresh, indicating that no hydrothermal action had taken place. Moreover, a geological examination of the mine by H. W. Turner proved the absence of structural features usually associated with downward enrichment. Further microscopical work revealed the coating of bornite by films and veins of chalcocite, formed largely by action on the bornite. The evidence generally indicated that chalcocite was the product of a secondary enrichment due to ascending solutions, presumably of an alkaline sulphide. This possible explanation has apparently never been proffered with regard to copper ores, though W. H. Weed in 1902 applied it to the formation of bonanza silver deposits. Mr. Weed does not introduce the theory in his monograph on the Butte deposits. As regards Butte, Reno H. Sales, in his recent paper quoted in our issue of October last, gave his view that the massive chalcocite in the lower levels of the Anaconda is a primary mineral, as distinct from the sooty chalcocite of the upper zones, which is allowed to be secondary. Mr. Rogers, after his experience in the mine in Plumas county, California, made microscopical examinations of Butte chalcocite, in order to test Mr. Sales' conclusions, which were not based on such considerations. In the present paper, Mr. Rogers presents slides showing that within the massive chalcocite are stringers and irregular pieces of bornite. From these facts he arrives at the conclusion that the chalcocite is secondary, having been formed at the expense of bornite by the agency of ascending solutions. The paper is well worth close study.

Cyanide Practice at Lake View & Star.—In the *Monthly Journal* of the Chamber of Mines of Western Australia for November, J. P. Caddy describes the practice at the cyanide plant of the Lake View & Star, Kalgoorlie, in connection with the precipitation and clean-up. The time occupied in clean-up is shorter than usual, only 18 hours being taken from the commencement of work on the boxes to the production of the bars, the gold slime is handled only twice a month, and the work is under the supervision of a responsible official all the time.

The solutions from the bromo-cyanide treatment of the raw slime and the ordinary cyanide treatment of the roasted concentrate run from the presses into the same sumps, from which it is pumped through two clarifiers to the gold-solution tank, after passing through a 3-in. Kennedy meter. From the tank, the solution is delivered to eleven extractor boxes each containing 12 compartments, eight of which are packed with zinc shavings. The zinc capacity of each box is 23 cu. ft., one cubic foot of zinc shavings weighing 12 lb. The quantity of solution passing through each box is about 75 tons per day, or 3·26 tons of solution per cu. ft. of zinc. The solution assayed: gold 12s. to 14s. per ton; cyanide as KCy, 0·06%; protective alkalinity nil. The boxes are dressed three times and cleaned-up twice a month. When dressing, the zinc is moved to the top of the box and new zinc packed in the lower compartments, after being dipped in a solution of lead acetate. The zinc consumption averages 3500 lb. per month. The precipitation is good, the tailing averaging under 1·8d. per ton.

The author describes the general clean-up at the end of the month; the intermediate clean up is done in a similar manner, but on a smaller scale.

The solution is syphoned from the boxes, and the short zinc and slime from the three top compartments removed in tubs to the washing tub. The washing tub is a wooden trough, 12 ft. by 3 ft. 6 in. by 2 ft. 6 in. deep, with sloping sides and bottom. It is divided into two compartments 8 ft. and 4 ft. long respectively, and has a 2-in. cock at the bottom of the lower end. A screen frame fits on the top about 6 in. below the water level, the larger compartment being covered with 20-mesh and the smaller with 10-mesh battery screening. The zinc is washed by hand on the two screens and returned to the boxes. The operation of cleaning out the boxes, washing, moving up the zinc and adding new zinc occupies under five hours, two men being employed on the boxes and four on the washing tub. When enough slime has collected in the tub to fill the press, about three hours after starting, it is run through the cock in the bottom to the monteju and then pressed, washed, and dried with air. The cakes of slime are then shovelled into the muffles, roasted for 1½ hours, fluxed and transferred to the tilt furnace. The tilt receives the first charge about 4½ hours after starting the clean-up, and the pressing and roasting are then kept ahead of the smelting. When all the zinc has been washed, the clear water is syphoned from the washing tub through a canvas filter. The slime which has passed the fine screen is run through a launder to the monteju, pressed, washed, and dried with air. The short zinc under the coarse screen is transferred to the acid tub. The acid tub is a lead-lined circular vat, 6 ft. diam. and 2 ft. deep, the bottom sloping to a 3-in. cock in the side. The tub is surrounded by a hood, in which is an air-pipe pointing upward. Generally, a tub of zinc too short to be returned to the boxes is picked out when washing and also treated with acid. Sulphuric acid (90%) is used, the consumption amounting approximately to 1100 lb. per month. After treatment the slime is mixed with water and then pressed, washed, and dried. The last of the gold slime is ready for roasting about 10 hours after starting the clean-up. The pressed slime is roasted in charges of 50 to 80 lb., each charge taking about 1½ hours. The roasted slime is raked from the muffles to trays, weighed, fluxed with borax (50%) and sand (10 to 15%), and charged into the tilt, which takes a charge of 200 lb. of roasted slime. If the roasting is ahead of the smelting, a No. 150 crucible in the well-furnace is used for smelting some of the slime. When sufficient bullion has been obtained, it is run down in a No. 60 crucible, and poured into bars of 700 oz. At the same time the amalgam collected during the month is retorted, and the gold run into bars. The value of the cyanide bullion is ascertained by a specific gravity test. The total clean-up products per month average: pressed slime 2800 lb; roasted slime 1220 lb; cyanide bullion 4200 oz.; amalgam bullion 1500 oz. The cyanide bullion assays, in parts per 1000: gold, 830; silver, 115; base, 55. The bullion from the concentrate amalgam assays: gold, 975; silver, 17; base, 8.

Beresite.—At the January meeting of the Institution of Mining and Metallurgy, C. W. Purington read a paper describing the gold deposits of Bereozovsk in the vicinity of Ekaterinburg, in the Ural mountains, and discussed the nature of the beresite dikes in which the gold is found. The word beresite was given by the Continental geologists to this igneous rock, which they generally regarded as a variety of granite. The distinguishing feature warranting a special name is the presence of auriferous pyrite which was considered to be primary, that is, introduced originally as part of the dikes and not subsequently by the waters of expiring vulcanism. The dikes are traversed by many quartz veins which contain gold in profitable amount, but the whole of the rock of the dikes also contains the pyrite with which the gold is associated. Mr. Purington has made a close microscopic study of this rock. Owing to the presence of phenocrysts of quartz he prefers to consider it as having been a quartz-porphyry, and he shows that the pyrite has been introduced with other minerals by metasomatism of the original rock. Thus the gold and pyrite are secondary minerals introduced after the formation of the dikes, and under these circumstances, the use of a specific term, beresite, is not really warranted from the petrological point of view.

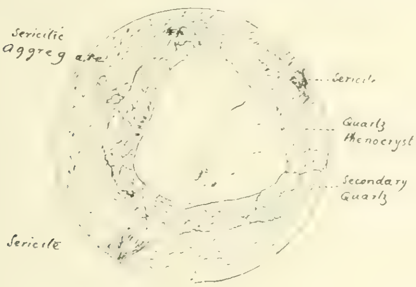


Fig. 1.

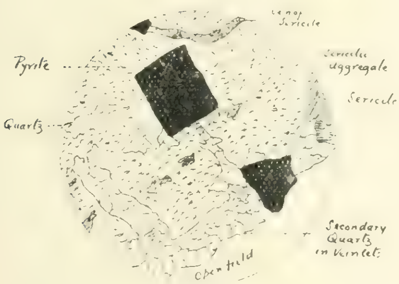


Fig. 2.

The beresite is a hard greenish-grey rock, fine and even grained. It consists of quartz and sericite, with here and there a phenocryst of quartz in dihexahedral form, and with a sprinkling of pyrite often in crystalline form as small cubes of less than 1 mm. The silica of the mass is exceedingly fine and not easily defined as such without a strong lens. The sericite is in fine silky scales. Here and there is a form resembling a pseudomorph after felspar. The beresite is structureless, and no laminations or variations in its consistency are visible. Under the microscope, the quartz phenocrysts are distinct, and though distorted, exhibit extinction parallel to the longer axis of the double prism. The accompanying Fig. 1 gives a slide which shows the phenocryst surrounded by quartz and sericite. Under the microscope the conditions of the latter are such as to lead us to the conclusion that they are secondary products due to partial metasomatism of the ground mass of the original quartz-porphyry. The pyrite crystals are seen to have sharp outlines, and fresh unpitted surfaces. On the edge of some of the phenocrysts, sharp-edged crystals of pyrite cut well into the crystals. The sericite occasionally breaks into the sharply-cut pyrite. In Fig. 2 there is a marked connection between a vein of quartz and a pyrite crystal, while another pyrite crystal is connected with a minute vein of sericite. The pyrite is evidently later than the phenocrystic quartz, and either earlier than or contemporary with the secondary quartz. In Fig. 3 bordering films of quartz are seen along the faces of pyrite. Waldemar Lindgren, in writing of similar occurrences in California, says that the films are characteristic of pyrite that has been formed by hydrothermal action. As already mentioned the profitable parts of these beresite dikes are confined to the transverse quartz veins. It is obvious that the silica and metals of these veins were introduced by solutions passing through these transverse fissures in the dikes. It is reasonable to infer that the changes affecting the original quartz-porphyry were accomplished by these solutions penetrating the rocks in the vicinity of the veins, and that the pyrite with which the gold is associated was introduced by them instead of being an original constituent of the dikes as hitherto supposed.

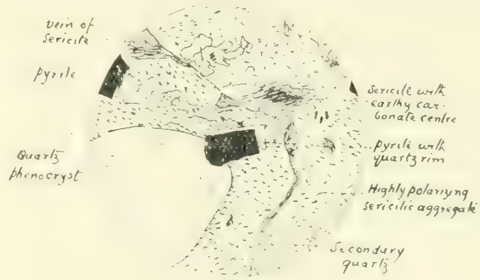


Fig. 3.

Smelting Cobalt Silver Ores.—In the *Canadian Mining Journal* for January 1, A. A. Cole describes the metallurgical methods used by the Canadian Copper company for the treatment of the ores of Cobalt, Ontario. The plant is situated near the company's copper-nickel smelter near Sudbury. Owing to alterations in the method of disposing of or treating the ores produced at Cobalt, largely the substitution of amalgamation-cyanidation, the Canadian Copper Co. is about to go out of the business. It is of interest, however, to place on record the method of treatment used. The ore is crushed to 30-mesh, and charged into a blast-furnace measuring 30 in. by 72 in., having a capacity of 25 to 30 tons per 24 hours. According to circumstances, limestone may be added as flux, or if an acid flux is required, some of the low-grade Cobalt ore is added. The products of smelting are silver, speiss, slag, and fume, the last-named containing much arsenic and silver. The silver produced constitutes about 75% of the silver in the ore. It has a fineness of about 850, and is refined in an oil-fired furnace to 980 fine. The speiss assays on an average 24% arsenic, 27% cobalt, 9% nickel, 2% copper, 6% sulphur, 20% iron, and 900 oz. silver per ton. After cooling, it is crushed to 30-mesh, mixed with 20% common salt, and sent to Edwards roasting furnaces. There are eight of these furnaces, each with a capacity of 1¼ tons per 24 hours. The chloridized speiss is taken from the furnace and sent to vats, where it is treated with water for the extraction of the soluble salts of cobalt, nickel, and copper. The solution is decanted and passed over scrap iron in order to precipitate the copper. The nickel and cobalt are precipitated as hydroxides by carbonate of soda. The hydroxides are dehydrated in a furnace, and the oxides are ground in a pebble-mill. This product averages 40% cobalt, 3% nickel, 0·3% arsenic, and 15 oz. silver per ton. It is sold for its cobalt content. In the chloridizing roast, a comparatively small amount of nickel is converted into the soluble salt. The speiss is afterward treated with a solution of hyposulphite of soda for the extraction of silver, all of which except 20 to 30 oz. per ton is dissolved. The silver is precipitated as sulphide by a saturated solution of nitrate of soda containing 10% carbonate of soda. The precipitate is heated to redness in an oil-fired roasting furnace, and subsequently placed in leaching vats to be treated with hot water. The remaining spongy mass averages 60 to 65% silver, and is sent to the silver-refining furnace. The residue from the hyposulphite process is mixed with quartz and smelted for the elimination of iron. The resulting slag contains silver and cobalt, and is smelted with other slags high in silver. The speiss, which contains 25 to 30% arsenic, 35% cobalt, 25% nickel, 3½% iron, 2% copper, and 300 oz. silver per ton, is treated in the same way as the first speiss by chloridizing-roasting and leaching with hyposulphite of soda. The arsenic in the residue is converted to arsenate of soda by roasting with nitrate and carbonate of soda, and removed by leaching. The residue after leaching averages 35 to 37% cobalt, 23 to 25% nickel, 3% copper, 5% iron, 0·3 to to 0·7% arsenic, and 20 to 30 oz. silver per ton. This is sold for its cobalt and nickel contents. The fumes produced in the smelting and roasting processes are collected and treated in an arsenic-refining furnace, and the residue, being high in silver, is returned to the blast-furnace.

Metallurgical Works in North America. — The statistical number of the *Engineering and Mining Journal*, dated January 10, contains particulars of the smelting and refining works in the United States, Canada, and Mexico, where the metals copper, lead, and zinc are produced. We append herewith the lists of names and addresses of the companies connected with these enterprises.

The following table gives details of the copper-smelting companies in North America:

COPPER-SMELTING.

American Smelting & Refining Co., Aguascalientes, Mexico.
,, ,, Perth Amboy, New Jersey.
,, ,, Omaha, Nebraska
,, ,, El Paso, Texas.
,, ,, Matehuala, Guanajuato, Mexico.
,, ,, Hayden, Arizona.
American Smelters Securities Co., Garfield, Utah.
,, ,, Tacoma, Washington.
,, ,, Velardena, Durango, Mexico.
Anaconda Copper Mining Co., Anaconda, Montana.
,, ,, Great Falls, Montana.
Arizona Copper Co., Clifton, Arizona.
Balaklala Consolidated, Coram, California.
Compagnie du Boleo, Santa Rosalia, Lower California, Mexico.
British Columbia Copper Co., Greenwood, British Columbia.
Calumet & Arizona, Douglas, Arizona.
Canadian Copper Co., Coppercliff, Ontario.
Cananea Consolidated, Cananea, Sonora, Mexico.
Consolidated Arizona Smelting Co., Humboldt, Arizona.
Consolidated Mining & Smelting Co., Trail, British Columbia.
Copper Queen Consolidated Copper Co., Douglas, Arizona.
Detroit Copper Mining Co., Morenci, Arizona.
Ducktown Sulphur, Copper, and Iron Co., Isabella, Tennessee.
East Butte Copper Mining Co., Butte, Montana.
Granby Consolidated, Grand Forks, British Columbia.
,, Anyox, British Columbia.
International S. & R. Co., Tooele, Utah.
,, Miami, Arizona.
Mammoth Copper Mining Co., Kennet, California.
Mason Valley Mines Co., Thompson, Nevada.
Mazapil Copper Co., Saltillo, Coahuila, Mexico.
Mond Nickel Co., Coniston, Ontario.
Mountian Copper Co., Martinez, California.
Nevada Consolidated, McGill, Nevada.
Nichols Copper Co , Laurel Hill, New York.
Old Dominion, Globe, Arizona.
International Nickel Co., Constable Hook, New Jersey.
Penn Mining Co., Campo Seco, California.
Pioneer Smelting Co., Corwin, Arizona.
Santa Fe Gold and Copper Co., San Pedro, New Mexico.
Shannon Copper Co., Clifton, Arizona.
Swansea Consolidated, Bouse, Arizona.
Tennessee Copper Co., Copperhill, Tennessee
Teziutlan Copper Co., Teziutlan, Puebla, Mexico.
Cia. Metalurgica de Torreon, Torreon, Coahuila, Mexico.
Tyee Copper Co., Ladysmith, British Columbia.
United States Smelting Co., Midvale, Utah.
Virginia Smelting Co., West Norfolk, Virginia.
United Verde Copper Co., Jerome, Arizona.
,, Clarkdale, Arizona.

The following table gives the names of the companies producing electrolytic copper in the United States:

COPPER REFINING.

Nichols Copper Co., Laurel Hill, New York,
Raritan Copper Works, Perth Amboy, New Jersey.
Baltimore Copper Smelting & Rolling Co., Canton, Maryland.
American Smelting & Refining Co., Perth Amboy, New Jersey.
U. S. Metals Refining Co., Chrome, New Jersey.
Balbach Smelting & Refining Co., Newark, New Jersey.
Anaconda Copper Mining Co., Great Falls, Montana.
Tacoma Smelting Co., Tacoma, Washington.
Calumet & Hecla Mining Co., Buffalo, New York.

The following table gives particulars of the lead smelters in the United States, Canada, and Mexico:

LEAD SMELTING.

UNITED STATES:

American Smelting & Refining Co., Denver, Colorado.
,, ,, Pueblo, ,,
,, ,, Durango. ,,
,, ,, Leadville, ,,
,, ,, Murray, Utah.
,, ,, East Helena, Montana.
,, ,, Omaha, Nebraska.
,, ,, Chicago.
,, ,, Perth Amboy, N.Y.
,, ,, El Paso, Texas.
American Smelters Securities Co., Selby, California.
Ohio & Colorado Smelting Co., Salida, Colorado.
U. S. Smelting Co., Midvale, Utah.
Needles Smelting Co., Needles, California.
Pennsylvania Smelting Co., Pittsburgh, Pa.
International Smg. & Ref. Co., Tooele, Utah.

MEXICO:

American Smelting & Refining Co., Montery,
,, ,, Aguascalientes
,, ,, Chihuahua.
,, ,, Velardena.
Compania Metalurgica Mexicana, San Luis Potosi.
Compania Metalurgica de Torreon, Torreon.
Compania Minera de Penoles, Mapimi.

CANADA:

Consolidated Mining & Smelting Co., Trail, British Columbia.

The following table gives the names of zinc-distilling companies in the United States:

ZINC DISTILLING.

Altoona Zinc Smelting Co., Altoona, Kansas.
American Zinc Co., of Ill., Hillsboro, Illinois.

American Zinc, Lead & Smg. Co., Dearing, Kansas.
" " Caney, Kansas.
Bartlesville Zinc Co., Bartlesville, Oklahoma.
" Collinsville, Oklahoma.
Chanute Zinc Co., Chanute, Kansas.
Collinsville Zinc Smg. Co., Collinsville, Illinois.
Edgar Zinc Co., St. Louis, Missouri.
" Cherryvale, Kansas.
Granby Mining & Smg. Co., Neodesha, Kansas.
" E. St. Louis, Illinois.
Grasselli Chemical Co., Clarksburg, West Virginia.
" Meadowbrook, "
Hegeler Bros., Danville, Illinois.
Illinois Zinc Co., Peru, Illinois.
La Harpe Spelter Co., La Harpe, Kansas.
Robert Lanyon Zinc & Acid Co., Hillsboro, Illinois.
Lanyon-Star Sm. Co., Bartlesville, Oklahoma.
Matthiessen & Hegeler Zinc Co., La Salle, Illinois.
Mineral Point Zinc Co., Depue, Illinois.
National Zinc Co., Bartlesville, Oklahoma.
" Springfield, Illinois.
Nevada Zinc Co., Nevada, Missouri.
New Jersey Zinc Co., Palmerton, Pennsylvania.
Pittsburg Zinc Co., Pittsburg, Kansas.
Prime Western Spelter Co., Gas City, Kansas.
Sandoval Zinc Co., Sandoval, Illinois.
Tulsa Fuel & Manufacturing Co., Collinsville, Oklahoma.
United States Zinc Co., Pueblo, Colorado.

Concentrating Tables in Australia.—In the *Mining and Engineering Review* for December, Wilton Shellshear, an engineer lately with the De Bavay company at Broken Hill and now with the Mount Morgan company, discusses the present practice in Australia with regard to concentration on tables. At present, opinions are equally divided as to the merits of the Wilfley linoleum-top table, as compared with grooved tables of the Card type. Most of the grooved tables now made have the grooves cut in a wooden deck. Linoleum, however, has long been recognized as a better dressing-surface, and it is, therefore, quite possible that this disadvantage may be overcome by the use of the new, thick type of linoleum, with specially cut grooves. The advantage of grooved tables lies in the fact that, as the mineral is discharged along the full width of the table, a much easier cut-off of concentrate from middling is obtained. Grooved tables are coming into favour for treating very fine material, and in some of the Broken Hill mines have taken the place of belt vanners. Apart from the question of regulation of speed and stroke for treating fine material by grooved tables, the shape of the groove is of importance. Thus when treating coarse granular material, the lower side is made vertical; but as the material to be treated becomes finer, this groove should be made flatter so as to prevent too big a scouring of the fine material in the grooves by the wash water. Although the Wilfley table double-toggle motion is at present largely used, the Weir-Meredith single-toggle motion is every day becoming more popular, owing to its lower cost of upkeep and less liability to get out of order.

In present-day table construction, hickory springs to support the deck are almost universally used, and the tendency is also to do away with the side-raising gear, so as to eliminate, as far as possible, the personal element in tabling operations. Experiments have proved that, if a series of tables, working under normal conditions, are examined, 90%, or even more, will be found to be working at the same angle. Once this angle is obtained, the side-raising gear may be dispensed with, and the table permanently set at the angle by adjusting the lengths of the springs accordingly. This makes the table construction simple, as the hickory springs supporting the table are bolted direct to iron angle brackets set on concrete. This method of construction is largely used in Broken Hill.

The feed is of great importance. In some plants the feed-box at the end of the table has been abolished. The feed is run in at right angles to the table, the feed-launder being widened gradually to about 18 in., and the feed distributed across the face of the launder by means of riffles, a piece of balata belt on the side of the table preventing wear where the feed drops on to it. This method prevents too great a scouring of the feed at the head end of the table. The tendency is to increase the number of tables in use, as the advantages of a light feed on each table more than compensates for the additional construction cost. This is recognized at Broken Hill, where the average is from 0·5 to 0·8 tons per hour per table.

The present trend of Broken Hill practice is to discard water-classification of table-feed altogether, the feed in most cases being simply distributed over groups of six or eight tables by means of automatic distributors and their connecting launders. Although this seems contrary to theoretical ideas, practice has shown that results are better than they used to be when the old systems of spitzkasten were used. When material is crushed, say, to 40-mesh, and fed direct to tables without classification, the coarser particles of the feed tend to entrap fine particles of mineral and carry them into the concentrate, that would otherwise be lost. It must also be remembered that a table itself acts as a classifier; the finer products pass off at the head end of the table, and can be re-treated over vanners or special tables as required. This method of treatment eliminates classifier troubles, and also reduces the water in circulation in the mill.

The present practice is to make a large middling product in the first system of tables, this product being separately treated on another set of tables. This practice tends to check ill-effects of irregular feed conditions. One middling table to three or four ordinary tables is common practice. The middling on the middling tables is usually returned to the head end of the table by means of a water jet.

The general principles of flotation have drawn the attention of milling men to the effect of aeration in causing loss of mineral particles, owing to their floating away with the dressing water. One Broken Hill mill has considered this of such importance that the tube-mills are purposely raised above the table flow, so that the feed from them goes on to the tables with a minimum amount of aeration.

Leaching Copper Ores.—The wet metallurgy of copper has of recent years been receiving attention in America, and we have lately given several extracts from articles on the subject. In the Annual Review Number of the *Engineering and Mining Journal*, January 10, there is a summary of some of the work now in hand at a great many mines. As regards electrolytic processes, the adoption of fused magnetite anodes marks a step in advance, this material being less liable to disintegration than anything yet tried, especially in the presence of chlorides. G. D. Van Arsdale, at the Copper Queen in Arizona, roasts low-grade porphyry ore, leaches with dilute sulphuric acid, and electrolyses; his point of novelty consists in injecting sulphurous acid into the electrolyte for its regeneration and for the reduction of the electric energy required. Stuart Croasdale, at the Calumet & Arizona mine, has developed the idea of using spongy iron obtained by smelting the roasted pyrite that has provided the sulphuric acid. The iron can be produced much cheaper than scrap iron can be bought. J. W. Bennie, of the Shannon mine, Arizona, in conjunction with F. S. Schimerka, has been working on a process that consists in roasting the ore, which is highly basic, with pyrite in order to sulphatize the copper. The spent liquor from the precipitation plant is poured over the roast heap in order to assist the action. The sulphate is leached by water and the copper precipitated on scrap iron.

Irving's Leaching Process.—In the *Mining and Scientific Press* for January 3, L. S. Austin describes the process invented by Joseph Irving, of Salt Lake City, for leaching oxidized and sulphide ores of copper. The crushed ore is subjected in leaching vats to the action of the mother liquor containing ferric sulphate from a prior leaching, to which has been added some sulphuric acid and common salt. The ore and solution are agitated and heated by injecting steam. The cupriferous solution obtained is passed through a filter consisting of sand and fresh iron pyrite, and then through the precipitation vats. Recovery of the metals may be accomplished by electrolysis or by passing the solution over scrap iron. The remaining solution can be regenerated for further use ; it is oxidized by a steam jet which agitates it violently, bringing it in contact with air. The solution is then reinforced with sulphuric acid and salt, and is ready to be used for a fresh charge.

Mackay's Leaching Process.—The United States patent 1,074,274, issued September 13 last, describes the electrolytic process, invented by Henry S. Mackay, of Riverside, California, and now being worked experimentally at Norwich, Connecticut, intended for leaching copper ores. A solution containing ferric chloride is made by electrolysing common salt, using an iron anode. The ore is agitated with this solution, whereby the copper is dissolved. The liquor is decanted, and the copper deposited electrolytically, the operation also reviving the solution. The patent is concerned chiefly with apparatus employed.

Flotation. — In the Columbia *School of Mines Quarterly* for November, Donald G. Campbell gives details of the results of experiments in connection with the concentration by flotation of an antimonial silver ore. This ore contained stibnite and stephanite, together with pyrite, finely disseminated through a silicious gangue. The sulphide minerals constituted about 5 or 6% of the ore. It was necessary to grind fine in order to dissociate the sulphides from the gangue. The author describes the Minerals Separation process, and the rapid agitator necessary to make a satisfactory froth, and proceeds to give his experience as to the efficacy of various oils, and the amount of acid employed.

The following oils were tried : cylinder and machine mineral oils ; sperm, fish, and whale oils ; corn, cottonseed, and rapeseed oils ; China-wood oil ; resin oil ; pine, and pine-tar oils. A number of tests showed that the first two oils did not form perceptible froths, but tended to agglomerate the sulphides into globules in the bottom of the jar. When the proportion of the sulphides was greatly increased, these globules broke up and showed a tendency to rise to the surface, due apparently to the adhesion of the oil to the air bubbles. In no case, however, was any decided froth formed by these mineral oils. Of the other oils, the sperm and the China-wood oils formed a froth which did not seem to be lasting, especially when the solution was acidified. The resin and the whale oils formed fairly good froths, but of a non-selective character, even in acid solution ; that is, even with a short period of agitation, a large amount of the silica was carried up into the froth, while much of the sulphide remained behind. The corn, cottonseed, and rapeseed oils gave better results ; but the most encouraging results of all were obtained from the pine oil, and the pine-tar oil. The latter, in particular, formed a very heavy froth with an exceedingly minute proportion of oil, required a comparatively short period of stirring to form the froth, which was exceedingly tenacious, standing for weeks without disintegrating. It was accordingly judged best to limit the succeeding experiments to the use of pine-tar oil as the frothing agent.

With even a small amount of acid present in the pulp, the effect is to reduce the total amount of the flotation product, and especially the amount of gangue that is carried up into the froth. For instance, as the mean of several experiments, it was found that when no acid was used the amount of froth product obtained from 100 grammes of ore, with 0·10 gm. of oil and 1 minute agitation, was 67 gm., and the recovery was 63%. Under the same conditions, but with the addition of 0·40 gm. of sulphuric acid, the weight of the froth product was only 32 gm. and the recovery had diminished to 49%. In other words, while the weight of the total product had diminished to one-half, the efficiency of recovery had diminished by 22%. This tendency toward lower recovery is offset by lengthening the agitation period, and by heating the solution, as will be brought out later. In the subsequent experiments, the amount of acid used was 0·4 gm. per 100 gm. of ore, as this seemed to give the most satisfactory results, as nearly as could be determined from the preliminary nature of the experiments.

In the tests as to the best amount of oil to be used, the proportion of oil to ore was varied, the amount used under the same conditions of agitation, with 100 gm. of ore, being 0·08, 0·16, 0·24, 0·32 gm. The recovery was 56, 63, 70, and 71% respectively. With oil in excess of this amount, an excessively large amount of gangue seemed to be carried into the froth, without a notably increased extraction. These results were obtained with three 1-minute agitation periods, the froth being skimmed off after each agitation. When the length of the agitation periods was increased, the amount of oil necessary was found to be very much less.

In a series of experiments to determine the best time to continue agitation, the length of agitation was varied from 1 to 8 minutes. At the lower limit, it was found that even a large proportion of oil did not result in as good an extraction as when the time was lengthened and the amount of oil was decreased. With the maximum agitation period, it was found that a high recovery could be made, but this was at the expense of a very impure froth, as much of the gangue was carried up into it, and the reduction ratio was therefore not satisfactory. Thus, as the result of tests with 200 gm. of ore at a charge, other conditions (amount of oil and acid) being the same :

Time of agitation.	Recovery.
1 minute	59%
2 ,,	71%
4 ,,	74%
8 ,,	77%

With the 4-minute agitation, the total froth product was 45 to 50%, and with the 8-minute agitation, was 65 to 70% of the total weight of the ore. It was accordingly decided that the shorter periods were the best, say around 2 minutes in this case.

In all of the foregoing tests, the agitator had been run at full speed, 1600 to 1800 r.p.m. This gave a peripheral speed to the agitator blades of about 1100 to 1200 ft. per minute. Several tests were now made to determine the effect of lowering this speed. As a result it was found that the recovery decreased rapidly with the decrease of speed, so that at half-speed the recovery was found to be only 46%. Hence the maximum speed was judged to be the most efficient, or 1100 to 1200 ft. per minute.

In the preceding tests, the temperature had been that of the room, or 65° F. In the results recorded below, five tests were made at the room temperature and another set of five at about 150°F. the other conditions being those found best in the different series of tests described above.

Ore, 200 gm. Oil, 0·20 gm. Length of agitation, three 2-min. periods. Acid, 80 gm.

	Recovery.	Weight of Froth.
150° F.	76%	60 gm.
65° ,, ...	71%	90 ,,

This showed an increased extraction of 5% in favour of the hot pulp, and an equally important advantage in the greater purity of the resulting froth. The heat, combined with the effect of the acid, seems to cause the particles of silica to coagulate, and thus prevent them from being carried up into the froth to as great an extent as in cold pulp. Even this weight of flotation product seems high; in practice, it would be reduced by again subjecting the product to agitation, perhaps several times. The original extraction, as well as the final or total extraction, would perhaps be greatly raised by finer grinding, and would certainly be raised by the mechanical and metallurgical improvements that careful study and experimentation would suggest in a large installed plant.

The results obtained in the foregoing tests lead to the following conclusions:

(1). Of the oils tested, pine-tar oil is the most effective froth producer, and seems to be most efficient when used in quantities approximating 0·1% of the ore.

(2). Without acid, the froth produced is non-selective; that is, the gangue is carried up into the froth almost impartially with the valuable mineral. As acid is added, the percentage of recovery may be diminished also, but the concentration is much more satisfactory. The amount of strong sulphuric acid that seems to produce the best results is approximately 0·4% of the ore.

(3). For good extraction, a rapid agitation must be obtained, a peripheral speed of 1100 to 1200 ft. per min. of the agitator blades being necessary.

(4). As the temperature is increased, the extraction is also increased; and the amount of oil necessary, as well as the time of agitation, may be diminished somewhat. The amount of the gangue carried into the froth is also greatly lessened, giving a much purer concentrate.

Magnetite Linings for Basic Converters.— The *Bulletin* of the American Institute of Mining Engineers for December contains a paper by Archer E. Wheeler and Milo W. Krejci, of Great Falls, Montana, describing their system of magnetite linings for basic copper converters, used for protecting the magnesite bricks. In their experience, the magnesite bricks were found to crack and scale, owing to the variations of temperature to which they are exposed in the various stages of the process, and to be worn by mechanical abrasion if they should become soft by being exposed to an abnormally high temperature. Experiments were therefore conducted with a view to producing a coating for these bricks that would have a higher melting point than the charge and be less liable to damage. Use was made of the fact that magnetite is formed when an artificial magma low in silica is blown. Any iron in excess of that required to combine with the silica is deposited in the form of Fe_3O_4. The melting point of magnetite is approximately 1530° C., and the ordinary working temperature of the converter rarely goes over 1200° C. The authors in their process first heat the converter newly lined with magnesite bricks to a bright red heat, and then charge it with liquid low-grade matte, without adding the usual silicious ore or other silicious material. The charge is alternately blown and cooled by the addition of cold matte, and when the whole charge has been converted to white metal it is removed. It is then found that magnetite has been deposited on the magnesite bricks. This blowing of matte without silica is repeated until the coating of magnetite is sufficiently thick. Further experiments are in hand with a view of dispensing with the costly magnesite bricks.

CURRENT LITERATURE.

Gold and Silver Metallurgy.—The *Mining and Scientific Press* for January 3 contains the yearly report by Alfred James on the progress in the metallurgy of gold and silver.

Granby Smelting Works.—In the *Engineering and Mining Journal* for January 3, C. C. Semple describes the new smelter now being erected by the Granby Consolidated at Hidden Creek, on the coast of British Columbia, near the Alaska boundary. The smelter has a capacity of 2000 tons per day. At the mine belonging to the company, close by, 8,000,000 tons of 2% copper ore has been developed.

Roasting Copper-Nickel Matte.—The Columbia *School of Mines Quarterly* for November contains a paper by E. F. Kern and M. H. Merris detailing experiments undertaken with a view of ascertaining the chemical reactions taking place in the roasting of copper-nickel matte.

Zinc Metallurgy.—In the *Mining and Scientific Press* for December 20, E. W. Hale records work done on complex sulphide ore, which is treated for zinc in the electric furnace with the formation of silver-lead bullion and copper matte.

Sampling Cobalt Silver Ores.—The *Canadian Mining Journal* for December 1 describes the Campbell-Deyell sampling plant at Cobalt, Ontario.

Canadian Mining.—At the January meeting of the Institution of Mining and Metallurgy, J. Mackintosh Bell read a paper giving a general survey of the mineral industry of Canada.

Queensland Tin.—The *Queensland Government Mining Journal* for December contains a lengthy report by E. C. Saint-Smith on the Stanthorpe tin-mining district in the south of Queensland, adjoining the New South Wales tin district.

Coal in Alaska.—In *The Colliery Engineer* for January, W. R. Crane describes the coal deposits on the Bering river, Alaska, and the method of developing them.

Alunite.—*Economic Geology* for December contains a paper by Frank C. Schrader on the occurrence of alunite in Arizona and Nevada. Alunite is the double sulphate of alumina and potash, and it is considered a likely source of potash fertilizer.

Nitrogen from the Air.—*Engineering* for January 30 describes the hydro-electric station at Rjukan, in the south of Norway, built for the purpose of fixing the nitrogen of the air by the Birkeland-Eyde process. The total horse-power is 145,000. Particulars of the process and its products were given in an editorial in our issue of June 1913.

Hydro-Electric Power for Cerro de Pasco.—*The Engineer* for January 16 gives an article with many illustrations describing the hydro-electric plant on the Yauli river, Peru, erected for the purpose of supplying electric power to the Cerro de Pasco and other copper mines. Our Lima correspondent refers to this subject in our columns of 'Special Correspondence' this month.

NEW BOOKS

The Sampling and Assay of the Precious Metals. By Ernest A. Smith. Cloth, octavo, 470 pages, illustrated. London: Charles Griffin & Co. Price 15s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

To the long list of valuable text-books published by Griffins dealing with mining and metallurgy is now added a book treating of the sampling and assay of the precious metals, gold, silver, and the members of the platinum group. The author has been responsible for many years for the assays at the Sheffield Assay Office, where gold and silver ware receives government approval, and where alloys of a variety of constitution and use are tested, containing platinum, palladium, ruthenium, iridium, osmium, etc. The author is particularly well qualified to write on the testing of these metals and alloys. His book contains a carefully chosen résumé of all the literature published on the subject in the technical press and transactions of societies, and in addition he gives many results of his own research not previously published.

Sampling is usually supposed to be the duty of the mine officials, and details of instruction generally therefore appear in books intended for the mine and smelter. The author considers rightly that the professional assayer is just as much interested in accurate results as anyone else, and therefore incorporates much useful information and many practical hints in his book. An important feature of the book is that it gives a large amount of space to the metals of the platinum group. The work of assaying such metals is confined to a comparatively small number of chemists, and the literature on the subject is scattered. Moreover the published accounts are by no means concordant. There is an excellent chapter on the valuing of ores, giving examples of smelter's charges and deductions and allowances for undesirable and desirable metals. In the chapter on sampling, the author publishes a number of tables, giving the ratio of the weight of sample taken to the size of the particles. He describes in detail the various methods of hand-sampling and machine-sampling, and gives instances of sampling mill practice. He gives particular attention to the preparation of the sample for assay, without which the sampling in bulk however carefully done is useless. Here he comes upon that difficult problem of fineness of pulverizing and the subsequent passing through sieves. In this connection I am particularly pleased to find how strongly he deprecates the practice of putting back the metallics into the mortar with a small quantity of ore and continuing grinding until all passes through the sieve. Two interesting chapters deal with slag formation, composition, and uses, and give a summary of materials used in the dry assay. Some interesting tables are given illustrating the losses in cupellation by absorption in the cupel, temperature variations, varying silver, and ratio of lead, and the protective action of silver upon the cupellation for gold. The author discusses the causes of these losses, and gives two, namely, infiltration into the cupel of minute particles of lead alloy, and the formation of small quantities of oxides of silver and gold that are dissolved in the molten litharge and thus absorbed. No doubt the temperature at which the cupellation is conducted largely influences the losses, but whether they are due to increased oxidation of the precious metal or to a decrease in the surface tension of the lead alloy is difficult to determine. The author proceeds to consider various special cases, such as arsenical ores, antimonial ores, cupriferous ores, telluride ores, and ores containing lead, zinc, nickel, cobalt, tin, bismuth, etc.

Full detail is given of the sampling and assaying of the precious metals in bullion, and of the work in the laboratory of a cyanide plant. As regards platinum and its allied metals, this is an important feature of the book, as already mentioned, and should be useful to those who have to value platinum in alloys, sweeps, and other products. The solubility of platinum in sulphuric acid is mentioned, and should be particularly noted, as, in boiling concentrated sulphuric acid, quite appreciable quantities are dissolved. For this reason the author recommends the procedure adopted by Steinmann of using a dilute acid for parting the silver. The value of this chapter is increased by the excellent bibliography that appears at the conclusion of the author's remarks. The author concludes with some useful tables and a full index. The book will undoubtedly be a valuable addition to the library of the assayer and analyst. A. J. CHAPMAN.

First Aid in Mining. By Louis D. Irvine, M.D. Pamphlet, 120 pages, with many illustrations. Johannesburg: The South African Red Cross Society. Price 1s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

The South African Red Cross Society was formed to inaugurate first-aid and ambulance work in the industrial, mining, and agricultural communities, to promote the study of hygiene in the home and in the schools, and to provide courses of instruction both for first-aid and for the nursing profession. The Mining Regulations issued in 1911 established standards of qualification for the possession of certificates on the part of those seeking responsible positions in the mines, and one of the necessary subjects was first-aid. The Red Cross Society thereupon commissioned Dr. Irvine, the medical officer of the Crown Mines, to prepare a handbook of instruction, suitable for use in connection with metalliferous mines. He is to be congratulated on his work, for it is terse, clear, and well illustrated. The instructions for carrying the victim of an accident and bringing him to the surface will be appreciated by the miner. The section on the relief of men suffering from nitrous fumes and carbonic oxide, almost always present after blasting, is of special interest, and the hints for interpreting the symptoms, a by-no-means easy matter, will prove valuable. Cyanide poisoning, also, receives due attention. The book will have a wide circulation in other parts of the world besides South Africa.

Pocket-Book for Miners and Metallurgists. By F. Danvers Power. Leather, pocket-size, 380 pages, illustrated. London: Crosby Lockwood & Son. Price 6s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

It is 22 years since Mr. Danvers Power first published his pocket-book. Between then and now much water has flowed under the metallurgical London Bridge. Thus it has become necessary for the author to rewrite the book and include references to the many recent advances in mining and metallurgy. The book contains a vast amount of information on a great variety of subjects, compressed into a small space. The first forty pages are devoted to the elements of arithmetic, algebra, trigonometry, and mensuration, tables of powers, natural sines and tangents, temperature equivalents, size of wire, weights of metals, etc. Then follow tables relating to measures of weight, capacity, etc., used in connection with all kinds of material, sizes of paper, perpetual calendar, rates of compound interest, etc. A chapter is devoted to knots and splices of rope, and another to the keeping of mining accounts and costs. Details are given of power production by water, steam, and electricity. Rates of discharge of water through pipes, power transmitted by ropes, and many other power problems are touched. Then come sections on blowpipe analysis, methods of assay, calculation of slags in fire metallurgy, lists of minerals and their determination, classification of rocks, sampling, mine examination, ore-dressing, and photography. The author in his preface states that the section on assaying has been mostly re-written by F. A. Eastaugh, that the tables of classification of rocks have been improved for the benefit of the miners, and that the information with regard to slags has been extended. It is impossible to compress complete information into so small a space as this book occupies, or to be quite accurate in all the details of so wide a field of knowledge. But the book is well worth the money asked.

The Petrology of the Igneous Rocks. Seventh Edition. By F. H. Hatch, Ph.D. Cloth, octavo, 460 pages, illustrated. London: George Allen & Co. Price 7s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

The first edition of Hatch's 'Petrology' was published in 1891. Just a year ago, the author, in conjunction with R. H. Rastall, extended the scope of the usual petrological studies by issuing a book on the petrology of sedimentary rocks. This new scheme made it desirable to re-write the original work and to extend it in many ways. Consequently the Seventh Edition now appearing is larger by a hundred pages, new chapters in the pyroclastic rocks and the metamorphic derivatives of the igneous rocks being added. The two volumes constitute a brief but complete survey of the science of rocks, in regard to their composition and structure, origin and metamorphism.

Mountains, their Origin, Growth, and Decay. By James Geikie. Cloth, octavo, 310 pages, with many photographs and other illustrations. Edinburgh: Oliver & Boyd; London: Gurney & Jackson. Price 12s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

It is well for the mining engineer to forsake the study of economic geology once in a while and sail the serener waters of pure science; or, shall we say, dabble in orography in place of ore deposits. Professors James Geikie and J. W. Gregory provide in their writings many opportunities for restful reading. The former's 'Structural Geology' is a favourite book. Now comes his work on the mountains. The photographs in themselves are sufficient to rivet the attention of the reader, especially those of Scottish and Swiss scenery. In style, the letterpress is not too deeply technical, and a convenient glossary is helpful to the reader not versed in geological terms. Let us quote a few sentences to show the author's happy blend of poetry and science: "Sentimentalists have sometimes expressed the fear that a study of the structure or anatomy of mountains may diminish one's appreciation of scenery. But surely it ought rather to lend an additional interest to our contemplation of Nature. A botanist is not less able to realize the beauty of flowers because he fully understands their structure and life-history; neither does an anatomist's knowledge of the human frame prevent his lively recognition of loveliness in woman." And throughout the book the author gives his description of various types of tectonic and relict mountains with infinite grace and charm.

The Quantitative Analysis of Molybdenum, Vanadium, and Wolfram. By Hans Mennicke. Paper covers, octavo, 225 pages. Berlin: M. Krayn. Price 9 marks. For sale at the Technical Bookshop of *The Mining Magazine*.

The author has collected much information concerning molybdenum, vanadium, and wolfram, particularly in connection with the quantitative analysis of their ores, steels, alloys, and chemical compounds. The various methods of analysis are divided into gravimetric, volumetric, electrolytic, and colorimetric methods, and the authority for each and its source is quoted. These analyses are further divided into those best suited to the various compounds, whether they be ores, steels, salts, or furnace products. The author rightly refers to the growing importance of these metals, and to the difficulty of accurately estimating these little known elements in an alloy or ore in presence of other metals. To the chemist who has only to make occasional estimations of molybdenum, vanadium, or wolfram, the question often arises as to whether the method he thinks of adopting is suitable for the particular compound under examination. The author is able to greatly facilitate matters in such a case, as he has personally tested the methods he gives, and can more or less guarantee them for the particular compound under which they are quoted. The book is in the German language and it is compiled with the usual German thoroughness. B.H.

Handbook on Petroleum. By J. H. Thomson, Boverton Redwood, and A. Cooper-Key. Cloth, octavo, 340 pages, illustrated. London: Charles Griffin & Co. Price 8s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*

This is the third edition of a book published nine years ago, written by the late J. H. Thomson, and intended for the use of inspectors appointed under the Petroleum Acts. Captain Thomson is succeeded as chief author of this book by Major Cooper-Key, the Government Inspector of Explosives. The book deals with the storage, transport, and industrial uses of petroleum and its products. The testing of petroleum products as regards flash-point occupies a large space. A section is also devoted to calcium carbide and acetylene. The government regulations regarding petroleum and calcium carbide are given in full.

Underground Waters for Commercial Purposes. By F. L. Rector. Cloth, octavo, 100 pages, illustrated. New York: John Wiley & Sons; London: Chapman & Hall. Price 4s. 6d. For sale at the Technical Bookshop of *The Mining Magazine*.

This book contains a study of the application of spring and well waters for drinking and industrial purposes, as distinct from surface waters. In America bottled water forms a growing industry quite distinct from what we know here as 'mineral waters' and 'medicinal waters.' Dr. Rector's book is intended more particularly to help those interested in the varying properties and characteristics of spring waters.

Excavating Machinery. By Allen Boyer McDaniell. Cloth, octavo, 340 pages, illustrated. New York: McGraw-Hill Book Co. Price 12s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This book is intended chiefly for the civil engineer, but is also useful to the mining engineer engaged in large-scale operations. Moving earth, rock, gravel, and mud, efficiently and cheaply, by digger, drag-line, steam shovel, and dredge, is the problem continually to be faced by members of our profession. This book enumerates the functions of the various machines, and wherever possible gives information of relative cost.

COMPANY REPORTS

Russo-Asiatic Corporation.—This company was formed in April 1912 for the purpose of developing mining properties in the Russian Empire. H. C. Hoover and Leslie Urquhart are the guiding spirits. The company may be considered as a continuation of the Anglo-Siberian Co., which financed the Kyshtim and Tanalyk and provided the technological advice. Two Russian banks, the Russo-Asiatic and the Banque du Commerce Privée, are participating. C. J. Cater Scott is chairman, and Leslie Urquhart managing director, while H. C. Hoover and R. Gilman Brown are on the board. A large number of properties have centration, averaging 5·5% lead, 1·2% copper, and 14·6 dwt. gold per ton. In addition there were 42,000 tons of oxidized ore assaying 14 dwt. gold. In order to test the continuity of the deposit, two bore-holes were put down, 250 ft. apart on the strike, and calculated to intersect the lode about 200 ft. below the bottom level on the dip. Where bore-hole 'A' struck the lode, there was first 23 ft. of solid sulphide, assaying 29·2% zinc, 19·1% lead, 2·06% copper, 7·8 oz. silver and 17·2 dwt. gold per ton. Following this 23 ft., there was 100 ft. of disseminated sulphides, averaging as far as assayed 4·5% lead, 8·3% zinc, 1·4 oz. silver and 15·2 dwt. gold per ton. After this came 122 ft. of gold ore assaying 11·4 dwt. per ton.

MAP SHOWING THE POSITION OF THE RUSSO-ASIATIC CORPORATION PROPERTIES.

been examined. It was not until last month that any negotiations had been completed. A meeting of shareholders was then called, and the nature of the various concessions so far acquired described in considerable detail. We give herewith an outline of the chairman's statement, and the accompanying map has been prepared from a sketch map circulated at the meeting. Three separate properties are to be developed in different parts of Siberia, two containing zinc-lead sulphides carrying precious metals, and the other being a coal deposit. The first in order of importance is the Ridder. This concession covers 3000 square miles and is in the southern part of the Altai mountains. Here a silver-lead mine was worked from 1778 to 1863, but operations terminated on the exhaustion of the oxidized ore. It was then found that the foot-wall contained gold, so the oxidized portion was mined by open-cut and treated in primitive stamp-mills until the year 1901. Reliable reports showed that at the time the mine was closed 98,000 tons of solid sulphide ore was standing above water-level averaging 28·5% zinc, 13·5% lead, 1·7% copper, and 16 dwt. gold per ton; together with 110,000 tons of ore requiring con-

The second bore-hole gave equally satisfactory results. It may be legitimately assumed that 1,300,000 tons of sulphide ore is in place between the bottom level and the horizon at which the bore-holes cut the lode. The gold ore is not included in this estimate. Another property close by is the Sokolni, which appears to contain similar ore. The development of the Ridder and Sokolni mines, and the concentration and further treatment of the ore, will be in the hands of T. J. Jones, D. P. Mitchell, and R. Gilman Brown.

The Nerchinsk concession covers 8000 square miles. Here also is an old silver-lead-zinc mine, the Kadainsky. The ore is much coarser than that at Ridder, which is similar to that from Broken Hill. The sulphides of zinc and lead can be largely separated by hand and subsequent water-concentration presents no difficulty. A drilling outfit has been dispatched so as to prospect the deposit on the dip. At the Ekibastus coal deposits, which have been examined by Forster Brown & Rees, of Cardiff, there are a large number of seams outcropping. The coal is of Carboniferous age and is of high quality, suitable for household purposes, steam-raising, and coking. Several shafts had been sunk by previous owners, and the company is now engaged in clearing the deepest workings.

Tongkah Harbour Tin Dredging.—This company was formed five years ago under Tasmanian laws for the purpose of dredging tin-gravel on the sea-shore on Tongkah island, off the coast of the Western Siamese States, in the upper part of the Malay Peninsula. The shares are almost entirely held in Australia. Our issues of July and October 1910 contained an account of the deposits, and of the widely diverse opinions as to their tin content held by various experts. It spite of some early adverse views, the results have been highly satisfactory, for during the three years of operation the production of tin concentrate has been 1142 tons, 1385 tons, and 1339 tons, and handsome profits have been made. The report for the year ended September 30 last shows that 3,336,180 cu. yd. of material was treated yielding 1339 tons of concentrate, as compared with 3,157,549 cu. yd. and 1385 tons the year before. The yield was 0·9 lb. per cu. yd., as compared with 0·98 cu. yd. The concentrate was sold for £158,517, being an average of £118. 7s. per ton, and the value of the yield per cu. yd. was 11·4d. The year before the average price per cu. yd. was £110. 16s., and the value of the yield 11·66d. per cu. yd. The dredging cost was £53,050, or 3·8d. per cu. yd., and other costs £9834, or 0·7d. per cu. yd., making a total cost of £62,885, or 4·5d. per cu. yd., as compared with 4·1d. the year before. The working profit was £95,632, out of which £7000 was paid as royalty and £7108 allowed for depreciation, leaving £81,524 as net profit. The shareholders received £60,000, the dividend being at the rate of 40%. It is proposed to redeem the £18,830 debentures in June 1915, and to pay for the sixth dredge just ordered, out of revenue, at the same time continuing to distribute quarterly dividends of 10 per cent. The directors have discussed the question of smelting on the spot, but have decided for the present, at any rate, to continue selling the concentrate to the Eastern Smelting Co. Dredge No. 6 was ordered in August from William Simons & Co. of Renfrew. It will be specially designed so as to make it capable of dredging to a depth of 60 ft. The accompanying plan shows the property, the parts dredged, and the position of the dredges. Eliot T. Lewis has succeeded M. T. Nelmes Bluck as manager.

GROUND WORKED BY THE TONGKAH HARBOUR TIN DREDGING COMPANY.

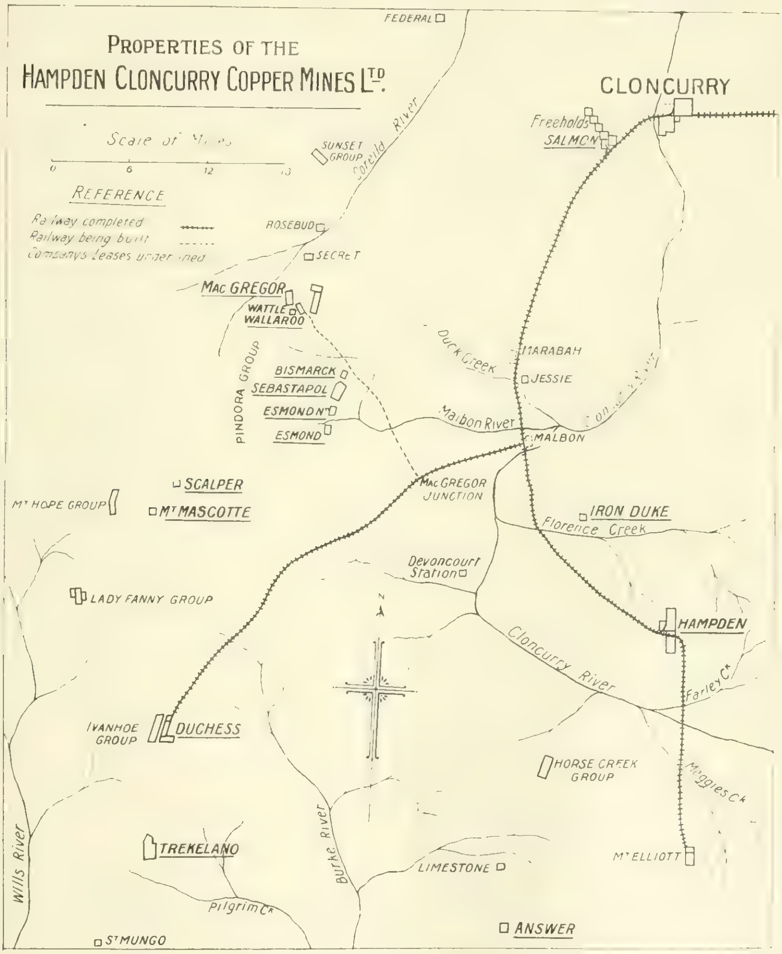
Wolfram Mining & Smelting.—This company was formed in 1909 to acquire from the Buitenlandsche Bankvereeniging of Amsterdam a number of wolfram mines at Silvares, Portugal. These mines had been worked by a local company for some years, and on the formation of the English company, additional capital was subscribed for the purpose of extending operations and building improved dressing plant. Reports were made by J. D. Kendall and J. W. Anderson. The issued capital is £80,000, and dividends have averaged 7½%. The report for the year ended September 30 shows that the sale of concentrate realized £25,641, the tonnage not being given. This figure compares with £29,337 the year before, the drop being caused partly by a flood in one of the workings and partly by the appearance of tin in some of the veins, which made it necessary to store the concentrate pending the erection of a magnetic separator. This machine is now at work. The balance of profit for the year was £6940, out of which £4000 has been distributed as dividend, and £1500 placed to capital expenditure account. The manager, G. F. Cowper, gives as usual a detailed report of operations at the mine and mill.

Ferreira Deep.—This company was formed in 1894 to acquire a deep level property on the dip of the Ferreira mine in the Central Rand. Regular production started after the war and dividends were first paid in 1904. Two years ago the small unexhausted portion of the Ferreira was acquired for 70,000 shares, the object being to remove the remaining ore in such a way as to protect the upper workings of the Deep. For two or three years recently the mine was greatly troubled with subsidence of the hanging wall, and special means of packing and sand-filling had to be devised for ensuring the safety of the workings and the shafts. During the last year conditions have greatly improved, and it has been possible to increase the output substantially. The report for the year ended September 30 last shows that 744,971 tons was raised, and after the removal of 13% waste, 647,550 tons averaging 43s. per ton was sent to the two mills, at which 245 stamps and 6 tube-mills were at work. The yield by amalgamation was 277,783 oz. gold, and by cyanide 91,588 oz., a total of 319,371 oz., worth £1,343,941, or 41s. 6d. per ton milled. The working cost was £649,387 or 20s. 1d. per ton, leaving a working profit of £694,553, or 21s. 5d. per ton. The yield per ton was 1s. 7d. higher and the cost 1s. 2d. less than during the previous year. Out of the profit, £63,121 was paid as profits tax, and £490,000 distributed as dividend, being at the rate of 50%. The total distribution to date has been £3,872,750, from 3,722,773 tons of ore. F. J. Trump, the manager, gives details of the present underground organization and of the methods adopted for the reclamation of the pillars in the upper levels of the Deep mine. The ore reserve on September 30 was estimated at 1,974,400 tons averaging 8·7 dwt. per ton, most of it being in the Main Reef Leader and South Reef.

Vogelstruis Estates & Gold Mines.—In 1888 a company called the Vogelstruis Gold Mining Co. was formed to acquire gold-mining claims on the outcrop in the middle west Rand, situated immediately to the east of the Roodepoort group. In 1893 the debenture holders took possession and sold it to new proprietors who formed the present company. A mill containing 80 stamps was started in 1896, but did not run for long owing to the limited supply of ore. Another start was made in 1903, and small dividends were paid in 1907, 1908, and 1909. The control is in London and the board includes such well known names as Struben and Molteno. H. Ross Skinner is consulting engineer, and R. A. Alston is manager. Two years ago it was supposed that the mine was rapidly approaching its end, but the report for the year ended June 30 last shows that developments have recently taken a turn for the better. During this time, the mill has been kept fully occupied, treating 147,603 tons, an increase of 22,475 tons as compared with the previous twelve months. The yield by amalgamation was 26,162 oz., and by cyanide 13,013 oz. In addition, 1625 oz. was recovered from accumulated slime. The realized value of the gold was £173,732, as compared with £148,496 the year before. The working profit for the year was £25,249. Against this was charged £1631 for London expenses, £5646 for debenture interest, and £26,738 for depreciation of plant. This drastic reduction has been rendered advisable owing to the necessity for extensively reconstructing the mill and power-plant, a work that is to be taken in hand shortly. The actual balance for the year was a debit of £8833, which added to the debit balance brought in from the previous year makes a total debit forward of £33,178. The ore reserve has been substantially increased during the year, from 120,000 tons to 207,000 tons. The limit of profitableness has been fixed at 4·3 dwt. per ton. This reserve is entirely in the South Reef, but the Main Reef is also supplying ore, 20% of last year's output coming from this source. It is figured that 31,636 tons, averaging 4·38 dwt. per ton is available for stoping in the Main Reef. During the last year or so, efforts have been made to reopen the old workings on the outcrop in the eastern section of the property, and a new shaft is being sunk. The share capital is £224,929, and the debentures amount to £94,100.

Knights Deep.—This company belongs to the Consolidated Gold Fields group, and owns properties on the dip of the Glencairn and Knights, two mines under Barnato control, situated in the middle east Rand. The southwest corner of Knights Deep is contiguous to the Simmer East, also of the Gold Fields group, but one that proved unsuccessful when run by itself. In October 1912 an arrangement was made to work the two mines conjointly, and afterward in July 1913 the Simmer East property was purchased outright. The report now issued covers the year ended July 31 last. During August and September 1912, 250 stamps were running, and for the rest of the year, after the agreement was made with Simmer East, 400 were employed. In May 1913 two more tube-mills were added, bringing the total to 11. During the year, 583,762 tons of Knights Deep ore was raised and treated, with an average content of 3·93 dwt. gold per ton, and 425,968 tons of Simmer East ore averaging 3·74 dwt. per ton. The extraction per ton was worth 15s. 2d. at Knights Deep, and 14s. 4d. at Simmer East, and the working costs were 10s. 6d. and 12s. 1d. respectively. The total working profit at the two mines was £185,053, or 3s. 8d. per ton. Profits tax absorbed £6924, debenture interest £5728, and £23,500 was devoted to the redemption of debentures. The shareholders received £144,793, being at the rate of 22½%. The ore reserve on July 31 was estimated at 1,544,500 tons averaging 4·36 dwt. per ton in Knights Deep, and 1,232,500 tons averaging 4·21 dwt. in Simmer East. Operations were hindered during the year by a fire at the crusher station, and by the labour troubles in June and July. The mill-capacity is now 120,000 tons per month.

Van Ryn Gold Mines Estate. — This company was formed in 1892 to acquire property on the outcrop in the far east Rand. A dividend was paid in 1895, but it was not until 1904 that steady prosperity was attained. The deposit is of lower grade than was characteristic of the outcrop mines of the central Rand. The mine was in fact the pioneer in the successful treatment of low-grade ore in the far east Rand. The control is with the Albus, and E. G. St. John is manager. Two years ago the metallurgical plant was overhauled and extended, and the ore reserve was substantially increased. The report for the year ended June 30 last shows that 494,721 tons of ore was raised, of which 38,621 was removed at the sorting station, and 456,090 tons sent to the mill. The average number of stamps running was 135. The yield by amalgamation was 106,832 oz., and by cyanide 43,614 oz., a total of 150,437 oz., worth £637,788, being a yield of 27s. 11d. per ton milled. The working cost was £364,868, or 16s. per ton, leaving a working profit of £272,919 or 11s. 11d. per ton. In addition, £21,009 was spent on capital account on machinery, etc., £25,598 was paid as profits tax, and £3656 paid to the Phthisis Compensation fund. The sum of £237,500 was distributed as dividend, being at the rate of 47½%. This is the highest yearly distribution on record, the previous highest being 45%, which was paid during the preceding four years. The output was slightly less than during the year before, on account of the suspension of operations owing to the strike at the end of June. The ore reserve has been fully maintained, and stood on June 30 at 2,064,529 tons averaging 6½ dwt. per ton. The development of the new section known as No. 3 mine has continued to give encouraging results.



sumption was not complete in all departments. Moreover the filling of the lower levels at No. 1 shaft at the Hampden mine caused a cessation of development work for several months. During the period under review, 7817 tons averaging 8½% copper was raised from the Hampden mine, and 11,040 tons averaging 16% from the Duchess. The smelter treated 27,744 tons, of which 8783 tons came from the Hampden, 12,129 tons from the Duchess, 2122 tons from the Salmon, and 502 tons from the Iron Duke, while the remainder, 1208 tons, was custom ore. The yield was 2626 tons of blister copper, containing 2596 tons of fine copper, 818 oz. gold, and 24,457 oz. silver. The ore reserve on August 31 was estimated by Erle Huntley, the manager, at 255,000 tons averaging 10%, its distribution among the various properties not being specified. The most important discovery was on the 350-ft. level on the Hampden mine, where a lense of high-grade ore was found that promises to yield a large amount of ore. The accounts for the half-year show a profit of £66,397, out of which £7817 was placed to reserve for depreciation, and £35,000 distributed among shareholders, being 2s. on each £1 share, of which there are 350,000.

Hampden Cloncurry Copper Mines.—This company was formed in Melbourne in 1906 by the Baillieu group for the purpose of acquiring the Hampden and Duchess copper properties in the Cloncurry district of North Queensland. More recently, the Trekelano, McGregor, Pindora, and Salmon properties were bought. The company also owns the Answer, Iron Duke, Mascotte, and Scalper mines. A smelter was erected in 1912. The company was reconstructed in 1909, and in 1913 additional shares were sold for the purpose of providing the funds for the purchase of the McGregor and Pindora groups. The report for the six months ended August 31 shows that all operations were suspended during June and July owing to labour troubles, and that after the end of July resumption was not complete in all departments.

Burbank's Main Lode.—This company was formed in 1896 to acquire a gold-mining property 4½ miles south of Coolgardie, West Australia. There have been several reconstructions, the last in 1904, and two years ago £11,475 additional capital was subscribed for the purpose of increasing the power-plant, bringing the total capital to £37,562. Dividends were first paid in 1906. The report for the year ended June 30 last shows that 22,934 tons of ore was raised and treated, yielding gold worth £52,268, being an extraction of 45s. 7d. per ton. The working cost was £31,082, leaving a working profit of £21,186, or 18s. 5d. per ton. Out of profit, £11,357 was spent on development, and £3249 allowed for depreciation; £2441 went as administration expenses and taxes. The net profit was £5446, out of which £1878 was distributed as dividend, being at the rate of 5%. The balance carried forward was £15,964. The development work on the 800-ft. and 900-ft. levels is giving promising results, for several shoots of ore carrying as much as 20 and 25 dwt. per ton have been found. The new power-plant is having the effect of lowering the operating cost. William Nicholas, Jr., is the manager.

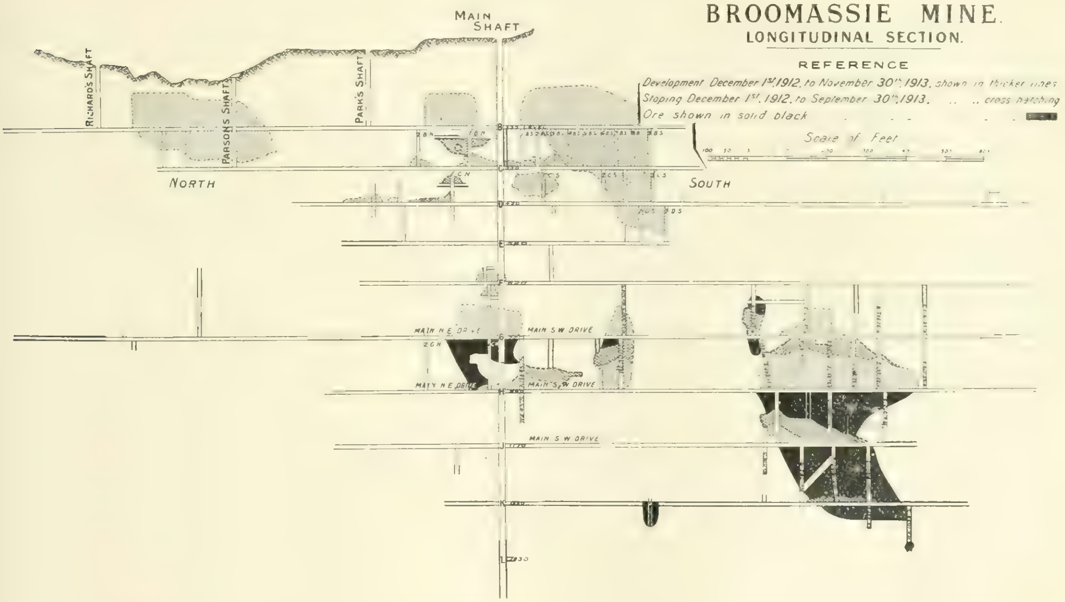
Cobalt Town Site Silver Mining.—This company was formed in 1906 to hold the shares of a Canadian company of similar name, owning property in the centre of Cobalt, Ontario. Dividends were first paid at the beginning of 1912. The report now issued covers only three months, July to September, this being done so as to bring the termination of the years of both the English and Canadian companies to September 30. Enclosed with the report of the English company is that of the Canadian company for 11 months ended September 30. During this period, 1023 tons of high-grade ore and 34,125 tons of concentrating ore were mined. The high-grade ore contained 1,435,685 oz. silver, and the concentrate produced from the low-grade ore 552,236 oz. The ore and concentrate shipped contained a total of 1,987,921 oz., and the amount received was $1,152,963. The net profit was $597,913, out of which $296,513 was distributed as dividend. During the period, £59,784 has been distributed by the English company to its shareholders. The most important discovery has been the 'X' vein. At the surface and in the upper parts prospected by the diamond-drill, this vein was none too promising, but where it was intersected by a cross-cut from the workings it was unusually rich. A large amount of ore has been extracted from it containing approximately 700,000 oz. It has proved to be erratic in content and width. Developments throughout the property have disclosed much low-grade ore, and it has become necessary to provide additional concentration facilities. A half-interest has therefore been bought in the Northern Customs Concentrator company, the price being $125,000. Of the capacity of this mill, 300 tons per day, the Town Site company will take 200 tons. The reserve of ore is estimated to contain 2,102,000 oz. W. R. P. Parker is president of the Canadian company, C. E. Watson is manager, and Sir Augustus Fitz-George is chairman of the English company.

Casey Cobalt.—This company was formed in 1907 to acquire the share capital of a Canadian company of similar name, owning property near New Liskeard, Ontario, to the northeast of Cobalt. The deposits are of the same nature as those at Cobalt. It is only recently that active development has been commenced. The report now issued covers the three months ended September 30 last, the odd period being caused by the rearrangement of the financial years of the English and Canadian companies. The report is accompanied by a report of the Canadian company covering the year ended September 30. During this time, the development has been actively pushed, electric power has been installed, and the mill has been enlarged. The benefit of the improvements has only been felt since the close of the year under review. The production during the year was 110 tons of high-grade ore averaging 3865 oz. silver per ton, and 170 tons of concentrate averaging 1067 oz. silver per ton. The silver content of the ore and concentrate shipped was 607,621 oz. The net profit was $196,970, which was carried forward. The developments at the mine have given satisfactory results as regards both high-grade and concentrating ore. The ore reserve is calculated to contain 1,438,500 oz. silver. The mill has been extended by the erection of 20 stamps, making 30 in all. The capital of the English company is £244,950. The debentures, £30,000, have been exchanged for shares. The directors state that since the close of the year the Canadian company has declared the first dividend, the amount of which is not stated. It however enables the English company to distribute £12,247 as dividend, being at the rate of 5%. The control is in the same hands as the Cobalt Town Site, particulars of which are given in the preceding paragraph. John W. Shaw is manager.

Jos Tin Area (Nigeria).—This company was formed in 1910 as a subsidiary of the Tin Areas of Nigeria. Assheton and Cyril D'Arcy Leaver are the controllers. Lake & Currie are the consulting engineers, and H. E. Nicholls is manager. The property is on the Delimi river, four miles from Naraguta, Nigeria. The company has also acquired leases in the Ropp district. An output has been maintained by calabashing, but a more important undertaking has been the building of a bucket dredge, particulars of which were given in our issue of April of last year. The report for the year ended July 31 shows that 210 tons of concentrate averaging 75% metal was recovered by calabashing at the Jos leases, and 37¾ tons during development and prospecting at the Ropp property. Details of the sales and of the mining cost are not given. The net profit was £13,897, out of which £2100 has been allowed for development redemption, £3000 placed to reserve, and £7500 distributed as dividend, being at the rate of 10%. The bucket dredge did not start work until after the close of the financial year. A preliminary run was made in October. In November 15 tons was recovered from 5450 cu. yd., and in December 23·7 tons from 10,150 cu. yd. The company also has interests in the Tin Areas of Cornwall, and in the German African Tins.

Frontino & Bolivia Gold.—This company was formed in 1864 to acquire a group of gold-mining properties in Colombia, South America, or as the country was called in those days, New Granada. Dividends were paid on a small scale for 15 years or so up to 1883, and also from 1888 to 1901. Subsequently the mines were allowed to drift without provision being made for altered circumstances of work, and three years ago the position became serious. Pellew-Harvey & Co. were then asked to examine and recommend reforms. In 1911, in order to bring the plant up to date and push development, the company was reconstructed and additional capital raised by assessing the ordinary shares by 6s. per £1. The capital now stands at £23,390 in cumulative 10% preference shares and £140,000 in ordinary shares; there are also £45,138 debentures carrying 10% interest. The report for the year ended June 30 last shows that 19,412 tons from the Silencio mine, 2783 tons from Donagan's, and 10,693 tons from Salada, a total of 32,888 tons, was mined and treated, yielding 20,167 oz. gold, worth £86,972. The cost was £71,674, and £918 was made from tributors. The profit was £16,216, out of which £2998 was allowed for depreciation, £1775 written off expenses incident to the formation of the company, and £4513 paid as interest on debentures. The year commenced with an adverse balance of £6003, and ended with a credit balance of £925. Development has been actively prosecuted by machine-drills, and during the year 4107 ft. was done. The ore reserve at the three properties was estimated at 15,900 tons averaging 18 dwt. per ton. The expenditure out of capital was £14,815, mostly on machinery and plant. Pellew-Harvey & Co., the consulting engineers, give much interesting information relating to the improvements above and below ground. Attention is being given to the improvement in cyanide extraction. G. A. Barber has recently been appointed manager.

curred at the last reorganization of operations. The yield per ton of ore was 76s. 10d. and the profit 22s. 10d. The development south of the main shaft has been actively conducted on the 1350-ft. level. The ore-shoot extended for a distance of 280 ft., as compared with 237 ft. on the 1170-ft. level. Winzes were sunk below the 1350-ft. level at points 935 ft. and 1035 ft. south of the shaft. In these, the shoot was found to be displaced by faulting, but it was once more intersected on sinking deeper at the 1035-ft. winze. Drifts north and south have been started, since the close of the financial year, at a depth of 1530 ft., from the bottom of this winze. In driving from the main shaft on the 1350-ft. level to intersect the shoot, ore was found at 360 to 400 ft. from the shaft, and a winze was sunk at 375 ft. in quartz stringers The average content of the ore disclosed throughout the depth of the winze, 98 ft., was 27½ dwt. over a width



of 42 in., but the full width is not yet exposed. Driving is to be commenced at the 1530-ft. level from the main shaft to intersect this new shoot as well as the main shoot. No ore has been found in the section of the ground to the north of the main shaft. The ore reserve on December 1 was estimated at 37,500 tons averaging 22½ dwt. per ton. The plant for roasting and cyaniding the concentrate has been erected and put into operation.

Broomassie Mines.—This company was formed in 1901 to acquire a gold-mining property at Broomassie, on the Ancobra river, about 20 miles northwest of Tarkwa, West Africa, together with dredging rights on the Ancobra and Mansi rivers. Two reconstructions have been necessary, the last in 1909, on which occasion Bewick, Moreing & Co. were appointed consulting engineers. After extensive development, milling was resumed in March 1911, and a year ago we were able to record that a first dividend of 10% had been paid. The report for the year ended September 30 last shows that the prosperity has been maintained and the dividend increased to 20%. During the year, 36,812 tons of ore was milled and bullion worth £132,015 recovered, together with 586 tons of concentrate estimated to contain gold worth £10,076. After allowing £20,670 for development redemption and £10,395 for depreciation, a net profit of £43,246 was made, out of which £40,035 has been distributed as dividend. Out of the balance brought forward from the previous year, £10,970 has been written off the extra expenditure on mining and administration in-

Witbank Colliery.—This company was formed in 1896 to acquire coal deposits in the Middelburg district of the Transvaal, situated about 90 miles east of Johannesburg. The control is with Neumann's, S. C. Thomson is consulting engineer, and J. K. Addie is manager. The sale of coal commenced in 1898, and the output gradually increased until 1909, since when the figures have been fairly regular. Two collieries are being worked, the Witbank and the Uitspan. The report for the year ended August 31 last shows that 499,892 tons was sold at Witbank, and 256,739 tons at Uitspan, being a total of 756,631 tons. The profit for the year was £73,323, out of which £52,500 was distributed as dividend, being at the rate of 25%. At both the mines, recent development has given excellent results. Since the commencement of operations in 1898, the total output has been 6,286,362 tons. The reserve is estimated as sufficient to maintain an output of 70,000 tons per month for 30 years.

Middleburg Steam Coal & Coke.—This company was formed in 1902, under the laws of Cape Colony, to acquire coal deposits in the Middelburg district of the Transvaal, that had been developed by a Johannesburg syndicate. It was reconstructed in 1906, and registered under English law, with a rearrangement of capital. The mine is close to the Witbank mentioned in the previous paragraph. The company has paid dividends since 1909. The report for the year ended June 30 last shows that 294,375 tons of coal was raised, being an increase of 31,235 tons as compared with the previous year, and 66,500 tons as compared with the year before. The present equipment could deal with 30,000 tons per month. The thickness of the seam and the quality of the coal have been fully maintained. No rock has to be broken with the coal, and the coal itself does not require cleaning. A system of mechanical haulage has been installed that reduces labour to a minimum, and coal-cutting machines are in use with satisfactory results. The profit for the year was £16,423, out of which £797 was paid as debenture interest at the rate of 6%, £2500 was placed to reserve, and £3000 placed to reserve against depreciation of shares held. The 5% preference shares received £3244, and the ordinary shares received £7084, being at the rate of 7½%. This company also owns through a subsidiary, the Transvaal Gold Trust, a gold mine at Pilgrim's Rest, in the Lydenburg district. A treatment plant has been erected and was started in October. It is now working on ore accumulated on the surface, and within a short time the mine ore, which assays 8 dwt. per ton, will be treated. The plant contains Nissen stamps, Chilean mill, and Hendryx agitators.

Welgedacht Exploration. — This company was formed in 1899 by Ochs Brothers to acquire property in the far east Rand, on the eastern side of Modder B, containing both coal and gold. The coal deposits were first developed. A bore-hole cut the gold deposit at 1908 ft., the core indicating an assay of 26 dwt. per ton over 10 in. A shaft was commenced in 1910 for the purpose of developing the gold deposit, but after sinking to 724 ft., an inrush of water made it necessary to suspend operations. Water is now supplied to the Rand Water Board and a revenue of over £500 per year made thereby. On the suspension of gold-mining operations, the shaft was adapted to the use of the coal mine, and is now employed as the main hoisting shaft. The report for the year ended June 30 last shows that 108,270 tons of coal was sold, and a profit of £5600 made. Developments continue to expose coal, but the deposit is irregular in form and in quality. It is estimated that the proved area contains sufficient coal to maintain an output of 11,000 tons per month for five years. No dividends have yet been paid. S. C. Thomson is consulting engineer, and Thomas Pearson manager.

Wankie Colliery.—This company was formed in 1899 and reconstructed in 1909. It owns the coal deposits in Southern Rhodesia between Bulawayo and the Victoria Falls. Edmund Davis is chairman, A. R. Thomson is manager, and the control is with the British South Africa Company. Dividends have been paid since 1910. The report for the year ended August 31 last shows that 237,566 tons of coal was raised. Of this amount, 170,326 tons was sold, 47,589 tons applied by the company for the manufacture of coke, power purposes, etc., and 19,651 tons discarded as shale and slack. The demand for coal and coke is increasing, and additional power-plant, washing-plant, and coke ovens are being erected. The deposit is being developed on a larger scale, and a new incline shaft has been started. The quality of the coal and regularity of the seam have been fully maintained, and the reserve is estimated at 1½ million tons, not including that left as pillars. The company also owns excellent clay deposits suitable for brick and fire-brick manufacture. Of the coal sold, 80,000 tons went to mines and other consumers, and 90,000 tons to the railways. The Tanganyika Concessions is a large buyer of coal, coke, and fireclay. The accounts for the year showed a profit of £36,944, out of which £35,457 has been paid as dividend, being at the rate of 17½%. Debentures to the amount of £20,000 have been redeemed during the year, leaving £40,000 outstanding.

New Chuquitambo Gold Mines.—This company was formed in 1901 with a capital of £400,000 to acquire from the Nimrod Syndicate, of which Lord Ernest Hamilton, Colonel W. H. MacGeorge, F. C. D. Haggard, and Frederick Löwy were directors, a group of gold-mining properties at La Quinua, in the district of Cerro de Pasco, Peru. The purchase price was £15,000 in cash and £270,000 in fully paid shares. The company was reconstructed in 1907, shareholders receiving one share for each 16 held. New shares have been also issued in 1909 and 1911. The present issued capital stands at £44,800. Small dividends on the reduced capital were paid in 1908, 1909, 1910, 1911, and 1912. The deposits carrying the gold are reported to be fossil placers, the filling of old river beds. The rock is soft and is mined by adit at a low cost. The average content is from 2½ to 5 dwt. per ton. The report for the year ended June 30,1913, shows that 23,673 tons of ore was treated, yielding gold worth £14,667. The profit was £2370, of which £1920 was applied to reducing the account for plant and development. The cyanide plant erected two years ago has proved a failure so far. Merricks, Crane & Co., who were for some time the consulting engineers, have resigned, and the responsibility is now entirely in the hands of J. Bonany, the manager. Mr. Bonany has been in control since the beginning of June last. The directors accepted an offer made by him to continue the driving of the Santiago adit at his own expense, he receiving one fully paid share of £1 for each pound spent by him. The returns are now reported to be more satisfactory, and the profits earned foreshadow a resumption of dividends.

Wheal Kitty & Penhalls.—The report of this company, operating the mine at St. Agnes, Cornwall, under the direction of J. H. Collins, for the half-year ended December 31 last shows that the amount of ore raised has been increased by 830 tons as compared with the previous six months, the figures being 7630 tons and 6804 tons respectively. The yield of black tin per ton also increased, from 24·5 lb. to 29·77 lb. The production of concentrate was 101 tons as compared with 74 tons. The total receipts were £11,484, and the net profit £914, out of which £349 has been paid as 10% dividend on the preference shares. A mill containing 10 Californian stamps has been purchased, and two Record tables. It has been necessary to erect a Brunton roasting furnace, as the ore now raised is more pyritic than formerly. The total cost per ton was 27s. 8d. The development work during the half-year amounted to 910 ft., or 1 ft. for 8·4 tons milled. Further particulars are given by our Camborne correspondent.

The Mining Magazine

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Managing Director.

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CONTENTS.

STATISTICS

Stocks of Copper in England and the Continent.
Reported by Henry R. Merton & Co. Tons of 2240 lb.

	Dec. 31 Tons	Jan. 31 Tons	Feb. 28 Tons
In England	11,598	10,419	10,399
In France	3,192	1,712	1,576
Afloat from Chile	2,300	1,700	2,750
Afloat from Australia	4,000	3,000	3,800
In Rotterdam	3,750	3,650	3,300
In Hamburg	3,594	3,842	3,994
In Bremen	1,176	1,621	1,134
In other European Ports	1,050	750	700
Total European visible supply	30,570	26,694	27,653

American Copper Producers' Association's Figures.
In Tons of 2240 lb.

	Production.	Deliveries Domestic	Deliveries Foreign	Deliveries Total	Stocks at end of month
Total, 1911	639,258	316,791	337,009	653,800	—
Total, 1912	706,052	365,920	333,212	699,132	—
January 1913	64,053	29,111	26,956	56,067	55,000
February	58,460	26,641	32,219	58,860	54,600
March	60,822	34,190	34,682	68,872	46,550
April	60,416	34,892	38,346	73,238	33,728
May	63,088	36,209	30,477	66,686	30,130
June	54,402	30,559	30,396	60,955	23,577
July	61,640	26,296	35,035	61,331	23,886
August	58,764	32,897	32,706	65,603	17,064
September	58,661	29,837	32,627	62,464	13,261
October	62,085	30,435	30,412	60,847	14,499
November	59,860	21,721	31,280	53,001	21,358
December	62,049	9,794	32,831	42,625	40,782
Total 1913	724,307	342,566	387,974	730,540	—
January 1914	58,826	21,409	39,266	60,675	38,933
February	54,715	21,244	37,455	58,699	34,949

Production of Gold in the Transvaal.

	Rand	Elsewhere	Total	Value
	Oz.	Oz.	Oz.	£
Year 1912	8,753,563	370,731	9,124,299	38,757,560
January 1913	760,981	28,409	789,390	3,353,116
February	702,394	31,728	734,122	3,118,352
March	760,324	30,228	790,552	3,358,050
April	755,858	29,116	784,974	3,334,358
May	761,349	32,957	794,306	3,373,998
June	716,267	30,810	747,077	3,173,382
July	625,107	30,282	655,389	2,783,917
August	697,686	30,410	728,096	3,092,754
September	676,411	29,775	706,186	2,999,686
October	687,515	30,916	718,431	3,051,701
November	644,320	29,166	673,486	2,860,788
December	642,786	30,029	672,815	2,857,938
Year 1913	8,430,998	363,826	8,794,824	37,358,040
January 1914	621,902	29,851	651,753	2,768,470
February	597,545	28,716	626,261	2,660,186

Cost and Profit on the Rand.

	Tons milled	Yield per ton	Cost per ton	Profit per ton	Total profit
		s. d.	s. d.	s. d.	£
Year 1912	25,486,361	29 2	19 3	9 11	12,678,095
Year 1913	25,628,432	27 9	17 11	9 6	12,189,105
January 1914	1 902,733	27 4	18 2	9 3	876,577

Gold Output of India.

Year 1912	Year 1913	Feb. 1914	Year 1914
£2,265,094	£2,299,315	£185,508	£378,648

Production of Gold in West Africa.

Year 1911 £	Year 1912 £	Year 1913 £	Jan. 1914 £
1,069,442	1,497,179	1,634,700	128,862

Natives Employed in the Transvaal Mines.

	Gold mines	Coal mines	Diamond mines	Total
January 31, 1913	200,090	8,789	13,912	222,791
February 28,	207,662	8,877	13,918	230,457
March 31	207,733	9,009	15,041	231,783
April 30	205,424	9,053	15,626	230,103
May 31	197,644	9,062	15,345	222,051
June 30	188,094	9,060	14,654	211,808
July 31	170,242	9,403	13,378	193,023
August 31	158,223	9,236	13,172	180,631
September 30	152,637	9,361	12,321	174,319
October 31	148,882	9,377	12,712	170,971
November 30	147,569	9,286	12,680	169,535
December 31	150,012	9,516	11,811	171,339
January 31, 1914	154,202	9,471	11,979	175,652
February 28	157,673	9,508	12,266	179,447

Production of Gold in Rhodesia.

Year 1910 £	Year 1911 £	Year 1912 £	Year 1913 £	Jan. 1914 £
2,568,201	2,647,894	2,707,368	2,903,267	249,032

Production of Gold in Western Australia.

	Export oz.	Mint oz.	Total oz.	Total value £
Total, 1910	363,496	1,209,856	1,573,352	6,682,042
Total, 1911	160,021	1,210,447	1,370,468	5,823,522
Total, 1912	83,589	1,199,080	1,282,669	5,449,057
Total, 1913	86,255	1,227,888	1,314,143	5,448,332
January, 1914	9,762	102,261	112,023	475,840
February	8,493	94,812	103,305	438,809

Other Australasian Gold Production.

	1912	1913	Feb. 1914	1914
	£		£	
Victoria	2,039,400	1,847,400	98,200*	98,200*
Queensland	1,484,160	1,118,610	85,800	149,100
New South Wales	702,129	635,703	46,141	113,124
New Zealand	1,345,115	1,345,131	123,758	249,716

* January figures only.

Nigerian Tin Production.
In tons of concentrate of unspecified content.

Year 1912 tons	1913 tons	Jan. 1914 tons
2,532	5,032	485

Production of Tin in Federated Malay States.
Estimated at 70% of concentrate shipped to smelters.

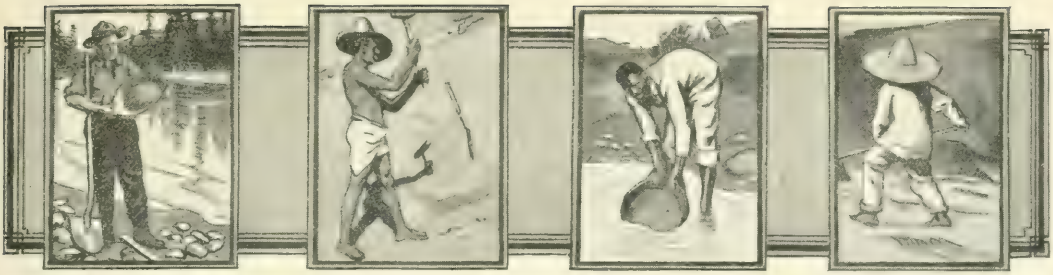
1911 tons	1912 tons	1913 tons	Jan. 1914 tons
43,967	48,250	50,128	4,893

Sale of Tin Concentrate at Redruth Ticketings.

	Tons	Value	Average
Year 1911	6151¼	£702,599	£114 4 5
Year 1912	6492	£831,908	£128 5 6
Year 1913	6186	£744,268	£120 2 6
January 5, 1914	202¼	£18,743	£92 13 6
January 19	232¼	£23,045	£96 6 6
February 2	231	£24,054	£104 2 7
February 16	232¼	£23,824	£102 11 7
March 2	234¼	£22,286	£95 2 9

Exports of Tin and Ore from Straits and Bolivia.
Reported by A. Strauss & Co.

	1912 tons	1913 tons	Feb. 1914 tons	1914 tons
Metal from Straits to Europe and America	59,036	62,533	5,525	11,760
Metallic Content from Bolivia to Europe	21,149	24,843	1,346	3,050



REVIEW · OF · MINING

INTRODUCTORY.—The period since we last reviewed the mining markets has been characterized by disappointment and timidity. Financial complications in Brazil, reflected at Paris and Brussels, have weakened the European bourses. The Mexican position has not improved, and partisan politics at home have threatened to involve insurrection in Ulster. Meanwhile railway finance in America has come under a new cloud owing to the Rock Island, Chesapeake, and Milwaukee difficulties. And as if there were not enough, we have had the usual March weather, with the chilly rain that sends hope shivering for shelter to an inconspicuous corner.

The chief centre of interest has been the Russian department, Russo-Asiatic continuing to rise at intervals to $7\frac{1}{2}$, while Russian Mining have had a spurt to $2\frac{1}{4}$, and Tanalyk to $3\frac{1}{4}$. The Kirkland Lake flotations have felt the weight of adverse criticism, and are quiet. The Rhodesian market is waiting anxiously for the results of the Cam & Motor and Shamva first crushings. Broken Hill shares have been strong, especially Sulphide Corporation, which is liberated from the danger of a heavy fine by the final decision in the Elmore-Minerals Separation litigation.

TRANSVAAL.—The output of gold in February was 626,261 ounces, worth £2,660,186, this being a decrease of 25,492 ounces in weight and £108,284 in value as compared with January; however, the difference of three days in the length of the respective months more than accounts for the decrease. As regards the labour supply, at the end of January the total employed in the gold mines was 157,673, this being a gain of 3471 as compared with the month previous. But it compares with 207,662 a year ago, and it must be remembered that this is the season when the supply is usually at its maximum.

The official statistics for 1913 indicate a decrease of 1s. 3d. in the yield, which was 27s. 9d., or $6\frac{1}{2}$ dwt. per ton. The working cost has decreased 9 pence per ton, to 17s. 11d. Hence the 'profit' is given as 9s. 6d., or 6d. less per ton than in 1912. But the total of dividends from the Rand is £8,194,099 as against the 'profit' of £12,189,105. Obviously only 67% of the theatrical profit reached the owners, that is, the shareholders, of the mine. The profits tax represents 8%. Is it not about time for the Chamber of Mines to drop these fictitious statements of profit? When the committee of engineers gave evidence before the Mining Industry Commission, it was stated that the method of deducting dividends from production to arrive at the cost was "drastic, but is the only one which exhibits the facts as far as the investor is concerned." Of course, it is. Any other method is grossly misleading. The correspondent of *The Financial Times* says that "this method has been criticized by the Government Mining Engineer, and is clearly unduly severe when conditions of the money market are such as to preclude raising of fresh capital, additional equipment and development having to be defrayed out of profits." If Mr. Kotze criticized the method, it was probably because it tended to segregate expenses at Johannesburg with those in London. The present 'profit' expresses an intermediate stage of book-keeping; as such, like any other item, it may be useful to the management, but as a statement of the return coming to the shareholder, it is worse than futile. Of course, to over-state the profit by 50% may help in the raising of fresh capital, but it is no more worthy of approval than any other false pretence.

We note that Mr. Warington Smyth, Secretary of Mines, has expressed the opinion that some of the natives are quite capable of supervising the work of the other natives underground. He did not say that the number of such men available was at all adequate to replace the white overseers, but his statement is important, for we regard Mr. Smyth as an authority second to none on this difficult question. In addition, he points to the fact that the majority of the white men, now supervising the work of the natives underground, acquired their knowledge of such work on the Rand after a short apprenticeship, so that their practical knowledge is distinctly limited. The consequence is that many of the natives under their direction are more skilled than themselves. Hence they become, in some cases, merely lazy spectators, rather than expert advisors to the coloured workers under them. Undoubtedly this fact has become realized since the strike, and accounts for the decreased employment for white miners. During the second half of 1913 the number of white miners on the Rand diminished by 4000, representing £1,250,000 per annum in wages. These developments are highly significant.

Our contemporary the *South African Mining Journal* makes interesting comment on the failure of the 'big mill' policy, pointing to the fact that while the tonnage of ore treated has increased 40% in the last six years, the profit has hardly improved, and the cost is almost stationary. This is in accord with our own views, namely, that the economic unit has been exceeded in the size of the mills and the magnitude of the consolidations. Beyond the economic limit, mere size means lack of efficient control. The most likely way of reducing cost is by improvement in the human machines employed to break and crush the ore.

The East Rand annual report conforms to our anticipations, and to the forecast of Mr. G. A. Troye. We note some discriminating comment on the subject by Mr. Rowland Feilding in *The Times*. The strike disturbances and the shortage of native labour were adverse factors, but they do not obscure the declining prosperity of the property. The outcrop mines are approaching exhaustion, while the deep-level areas are anything but promising. The inclusion of 8,550,000 tons of 4·3 dwt. banket is only misleading, seeing that the total cost is equivalent to 5 dwt. per ton. "Lack of candour" is too kind a term for such indirection.

We note that the management of the East Rand Proprietary has taken the lead in making arrangements for improving the conditions of living and for redressing the legitimate grievances of employees. At the same time, steps are being taken to prevent capricious dismissal of men by subordinate officers of the company. A workmen's committee of 12 is to be recognized as a channel through which representations may be made in respect of any of these matters. This new departure is highly creditable to the sagacity of Sir George Farrar and Mr. W. T. Anderson.

Some alarm was caused among shareholders in the Transvaal Gold Mining Estates by a report that the Duke's Hill mine had gone wrong. An official cablegram contradicted the rumour completely, stating that this particular mine was developing most satisfactorily.

RHODESIA.—The production of gold in January was 59,212 ounces, worth £249,032, comparing with £254,687 in December and £220,776 in the previous January. Among individual changes the Eldorado and the Globe &

Phœnix show decreases, while the Lonely Reef made a small gain.

Developments in the Shagari district, 25 miles northeast of Gatooma, are promising, although on a small scale. The principal mine so far is the Turkois, which has opened up an encouraging amount of 9 dwt. ore down to 400 feet in depth.

The trial crushings at the Shamva and Cam & Motor are being extended over a period exceeding a month, doubtless in order to overcome the little difficulties incidental to a first start. In the case of the Shamva, it is stated officially that the extraction is excellent, confirming both the metallurgical and mining estimates. At the Cam & Motor, it is likely that some readjustments of the plant may be required, for the ore is by no means of the simplest character.

West Africa.—The January output of gold was worth £128,862, as against £144,262 in the previous January; otherwise the statistics call for no comment. The Bibiani, of course, has ceased to contribute; last January it yielded £5250.

The Benue company has arranged to substitute steam-engines for the Diesel oil-engines sent out with the dredge. It is a pity that the experiment should have been tried in such a case. The new engines are expected to be in place by August. At the Jos similar engines are undergoing readjustment, in the hope of making them serviceable.

That sinister name Jemaa is again in evidence, owing to a favourable report on the Kassa and West Ropp tin areas made by Mr. Allan Davidson for the Jemaa Exploration Co. He finds that the technical evidence obtained by him warrants systematic testing of the ground. On this news the shares rose to 1¼, for 13,700 shares, as against a recent price of 10 shillings.

Canada. — Excessive cold weather has been experienced in Northern Ontario during February; a temperature of −62° being registered at Swastika and Kirkland Lake. Brilliant sunshine accompanied this frigidity, but fortunately no wind.

Several Kirkland Lake flotations have been made, but none that is important. The Burnside Mines has been registered, and the prospectus is likely to appear shortly. Mr. F. H. Hatch is expected on his return from the district; his report on the Kirkland Lake Exploration Company's prospects is awaited with keen interest.

The Tough-Oakes prospectus appeared on March 10. It calls for no special comment, being based on reports criticized in our last issue. Some adverse criticism has appeared also in the Canadian financial press, more particularly in regard to the apparent discrepancy between the reports of Messrs. H. H. Johnson and Charles A. O'Connell, the latter being the resident manager for the Kirkland Lake Proprietary company and of its chief subsidiary, the Tough-Oakes mine. Mr. O'Connell, in his report of January 24, said that "the gross value of the ore blocked out on three sides [in the Tough-Oakes] is over $750,000." He also said that "the average value of the milling ore exposed to date is taken at $23·30 per ton." This appears discrepant with Mr. Johnson's estimate of £220,000 gross, and $26·90 average, but the latter includes 19,000 of 'probable' ore in his grand total, and only 12,000 tons of 'positive' ore. Mr. O'Connell's total consists of 19,550 tons of $23 mill-ore and 457 tons of $470 smelting ore, making $679,650, together with the additional ore discovered since December 2, when his original estimate was made. Therefore, the statements are not directly comparable. At the same time, Mr. O'Connell seems to us to have included in his estimate all the ore that was assured at the time, so that his £150,000 does make the "over £400,000" of the 'management'—the vendors —seem more flamboyant than ever. We know that a first-rate engineer has made an estimate of only £100,000 worth of ore actually assured in the Tough-Oakes mine.

In our last issue an error was made in referring to the Teck-Hughes as the deepest mine in the Kirkland Lake district; this distinction belongs to the Tough-Oakes, which is now down about 250 feet and is being deepened. Going west on the 100 and 200-ft. levels, the No. 2 vein is now entirely in porphyry. On the second level, the vein has split, the drift following the northern branch.

A desirable combination is to be made of the Cobalt Lake, Cobalt Townsite, Townsite Extension, and City of Cobalt companies, all of which are in the same neighbourhood and under the control of the same group, identified with the firm of Rose & Van Cutsem, brokers who are about to resign from the Stock Exchange in order to devote their energies to mining finance, in which they have been recently so successful. The capital of the consolidated company is to be £1,660,000 in £1 shares. For the current year the net profits of the four companies are estimated at £285,000. The Casey Cobalt, another mine controlled by this group, is maintained as a separate unit. Mr. D'Arcy Weatherbe is consulting engineer.

The mill at the Crown Porcupine is doing good work; apart from a cost that compares favourably with the larger plants, we understand that continuous decantation with Dorr thickeners is successful to the extent of leaving only 30% moisture, thereby facilitating effective cyanidation.

The Le Roi No. 2 has arranged for the exploratory work on the South Rodney orebody to be conducted through the 1650-ft. level of the adjoining Le Roi mine, thus saving the sinking of the main shaft. The winze below the 1500-ft. level shows 22 feet of ore assaying $16 per ton.

AUSTRALASIA.—The Tasmania mine, at Beaconsfield, Tasmania, is to be shut-down after an earnest effort to make the best of adverse circumstances. Deeper development on the 1370 and 1500-ft. levels had disclosed ore averaging $8\frac{3}{4}$ and 13 dwt., respectively, for lengths of 1265 and 940 feet, respectively, and a width on both levels of 7 feet. But with increasing depth had come greater refractoriness, so that the extraction decreases seriously. This, taken with the fact that the width of stoping in this mine is 50% more than the assay-width, renders the vein in these lower workings unprofitable. These facts have been frankly stated in reports by the manager, Mr. C. F. Heathcote, and by Mr. Arthur Llewellyn, specially deputed by John Taylor & Sons to investigate the circumstances. They join in advising that the mine does not justify the heavy expenditure necessary for deeper exploration. Work in the Tasmania has been severely handicapped by excessive water. In 1904 one of the largest pumping equipments was provided at a cost of £120,000. The average cost of pumping during the last three years has been 6s. 8d. per ton of ore milled. This splendid pumping machinery will now be for sale.

The smelter at Chillagoe has been shut-down pending the completion of the railway to the Mount Mulligan coalfield. This action of the company is a protest against the Queensland Government's dilatory policy. A favourable report has been made on the purchase of the Chillagoe railway by the Government, but no further action has been taken. Meanwhile, the excessive cost of fuel has pressed heavily on the smelting operations. The Chillagoe company asked the Government for an advance of £30,000, which was refused. Hence the shut-down. Work continues at Mount Mulligan. It is added that recently an effort to expedite the completion of the railway to the coalfield has become apparent, so that it is hoped that the line will be available in September.

The February return from Great Cobar was disappointing, particularly as the January figures had been encouraging. A shortage of water and labour continues to hamper operations. The uncertain financial position of the company has become known to the miners, who, therefore, are migrating to Mount Morgan, where special inducements are being offered. Mr. H. C. Bellinger, lately the manager, is leaving the mine at the end of the current month, after having exhibited an excellent spirit of loyalty to the enterprise by remaining for three months and assisting the new manager, Mr. G. C. Klug, to obtain a firm grasp of affairs. On the other hand, Mr. G. E. Baker, a director deputed to be the company's local representative temporarily, resigned precipitately. Another resignation is that of Mr. E. H. Laird, who was recently brought from New Mexico to superintend the concentrator and the Chesney mine. The concentrator is closed-down, it being apparent that the cost of treatment, under existing arrangements, is prohibitive. Negotiations for an adjustment of interests are pending between the directors and the principal debenture-holders. We hear that developments in the upper workings, near Barton's shaft, are encouraging, but nothing is doing in the bottom of the mine. Connections between the Great Cobar 12th level and the North mine have been made, with a view to improving the ventilation.

RUSSIA.—We publish an editorial article on the Altai region that should prove interesting to those participating in the Russo-Asiatic and Russian Mining ventures. As regards the latter, we are able to state that an option has been taken—conditional on litigation being concluded—on a half-interest in the Vagliano anthracite mine. Some municipal projects at St. Petersburg are regarded as promising. Next, and most important, comes the Thurn und Taxis concession in the Altai. A number of old and extensive workings exist; these have been exploited only for their oxidized ores by primitive methods; hence it is anticipated confidently that under each of these old workings will be found large bodies of sulphide ore, as on the Ridder.

As regards the Thurn und Taxis concession, it is a fact that the area controlled by the Russo-Asiatic represents only a fraction of the entire original concession, which covered 23,500 square miles. When the Prince found that the labour and other requirements were too burdensome, he dropped the central portion of 3000 square miles on which is the Ridder mine, so that later the Russo-Asiatic was able to acquire rights to this portion direct from the Government; in his subsequent deal with the Russian Mining he included 14,000 square miles, for which he will be paid, if the option is exercised, £62,500 in cash and 15% of the shares issued. On the area thus optioned, there are numerous old mines examined by Mr. R. A. Varden in 1904. He made a comprehensive report. In that report, Mr. Varden speaks highly of the prospects of the Zeranovsk mine, at one time worked by a French company. Here he found reserves of ore amounting to 133,536 tons, assaying 7 dwt. in gold and 19 oz. in silver, besides 11% lead, 23% zinc, and 2½% copper. Indeed, the prospects are good, and we only hope that they will not be discounted furiously in advance, as has been done in the case of the Russo-Asiatic. Messrs. J. P. Hutchins and E. D. McDermott are on their way to the Altai to start diamond-drilling for the Russian Mining Corporation. An issue of 25,000 shares is shortly to be made, increasing the capital of the corporation to £250,000. It has been decided not to bring out a subsidiary on the strength of the option, but to proceed with testing and other preliminaries. This is commendable.

Developments at the Ridder mine of the Russo-Asiatic continue satisfactory. A third bore-hole has cut 18 feet of massive sulphide ore, and to date 60 to 70 feet of concentrating and hornstone ore. No assays have been received from this, a delay being caused by the burning of the Kyshtim assay-office. Temporary arrangements for assaying have been made. The mine has been unwatered and is now being cleared preparatory to systematic sampling. All the machinery for the testing plant has been shipped. Mr. G. A. Harrison is in charge.

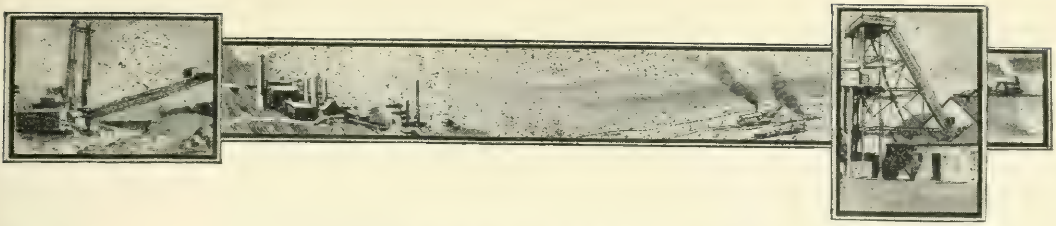
At the Tanalyk two important discoveries have been made in the Eulali prospect, which has been subjected to superficial exploration for some time past. A bore-hole at 275 feet vertical has cut 8 feet of 3% copper ore; and a shaft is now being sunk to reach this ore-body. On the Semeonovsky shallow shafts and cross-cuts have now disclosed a gossan from 12 to 40 feet wide, and at least 300 feet long, assaying over 10 dwt. gold and 46 to 48% iron, indicating the cap of an important body of pyritic ore. Deep drilling has been started under this outcrop. The construction of the new smelter has been delayed by bad weather, but it is hoped that the reverberatory furnace will be completed during April.

INDIA.—The report of the Mysore company for 1913 shows that the ore developed during the year in Ribblesdale's and McTaggart's sections has been below the average of recent years, but on the other hand Tennant's has lived up to its old reputation of providing high-grade ore. The reserve is equal to four years' supply, the average grade not being given. The working cost has increased by rather more than 1 shilling per ton, standing, according to the report, at 24 shillings per ton. If the expenditure on plant and shaft-sinking, royalty, income tax, and depreciation are included, the cost per ton was 35 shillings. The tonnage milled was 302,662 tons, averaging 15 dwt., and the yield was worth £905,090, or just under 60 shillings per ton. The shareholders received £380,250, being at the rate of 125%, or 25s. per ton of ore milled. A plant for treating the slime, with a capacity of 500 tons per day, has been ordered, and should be ready for work before the end of the year.

UNITED STATES.—On another page we comment at length on the work in progress near Juneau. In addition to the expansion of operations on the Treadwell, Gastineau, Juneau, and Ebner properties, a good deal of activity is apparent farther afield. The Nevada Creek mine, southeast of Treadwell, the Drum Lummond, west of the town of Douglas, the Cornet, on the opposite mainland, and the Jaulin, just over the hill, are all being revived by new development. Promoters and prospectors have foregathered of late, scenting business, and it is likely that this southeastern coast of Alaska will before long be the scene of a mining boom of no mean magnitude.

Excellent progress is being made at the Plymouth Consolidated, in California, the underlie shaft having been sunk 112 feet below the 1600-ft. level, while the rises from the 1850 and 2000-ft. levels have been extended 197 feet in all. Connection is likely to be completed by April 15. When this is done the development work on the 2000-ft. level will be resumed.

MEXICO.—The murder of Benton in Chihuahua has been followed by insolent pseudo-diplomatic negotiations between the chief bandit, Villa, and his leader, Carranza, on the one hand, and the governments at Washington and in London, on the other. William S. Benton, an Englishman well-known in northern Mexico, called upon Villa to protest against the invasion of his ranch and the theft of his cattle. He was murdered. Demands made by the American and British authorities for an investigation of the circumstances and of the body of the murdered man were evaded under cover of civilized negotiations. The general result has been to show the ineptitude of diplomatic protest when applied to the brigands now terrorizing northern Mexico. The United States will be compelled to choose between military intervention or being flouted *ad nauseam* by ruffians posing as reformers.



EDITORIAL

PATENT LITIGATION goes to prove the value of accuracy in the use of technical terms.

ROYAL SCHOOL OF MINES men are reminded of the annual dinner, to take place on Wednesday, March 18, at the Café Monico. Tickets can be procured from the Hon. Secretary, Mr. T. A. Rickard, at 724, Salisbury House.

WE NOTE the passage of the bill to construct a government railway to the Yukon river. This is an event of far-reaching importance to the great mineral region of the Northwest. Alaska is destined to attract increasing attention in the near future, as is suggested by the article we publish on the developments now in progress in the mountains behind Juneau.

HIGH RATES of transport continue to irritate and to hinder mine operators in Nigeria. The Government railway is making a handsome profit at the expense of the mining companies, and to the general detriment of the Colony. We hope that the protest made to the Colonial Office will result in a recognition of economic justice to those who are developing the mineral resources of the region.

A WORD often misused is 'fiscal.' The Casey Cobalt company in its last yearly report refers to the "fiscal year ended September 30," meaning the 'financial' year, that is, the year covered by the accounts presented. The use of 'fiscal' should be confined to operations connected with the public purse, especially the revenue and the taxes providing it. When the Tory party went mad on their proposed protective tariff, their disease was dubbed 'fiscalitis.'

REDUCTION of the price of *The Times* to one penny is an event in the history of the daily press. We welcome the change as likely to widen the influence of clean journalism. If only *The Times* could revert to its non-partisan pose on political matters, as in days gone-by, we believe it would strengthen its influence among thinking men and women. One other blemish persists, and that is the publication of reading notices laudatory of goods advertised in its columns. These 'write-ups'—an ugly word suited to the thing designated—are a blot on a great newspaper and detract from the trust of its readers. In that regard *The Times* sets a bad example.

LOTS of buncombe is written on radium, in newspapers and prospectuses. We are surprised, however, to read one of the worst of the 'popular' renderings of radium romance in the *Daily Chronicle*, which, on February 18, published an article in which, *inter alia*, it was stated that the chief mineral yielding radium was pitchblende, "a heavy black ore, looking like graphite." It only resembles graphite in being black. "It occurs in small fragments, and is composed of a number of different substances, one of which is always lead." Yet the article is stated to be written "By a Scientist." It must have been a Christian Scientist, otherwise a person who believes things he knows to be untrue.

LORD CLAUD HAMILTON'S *gaucherie*, in regard to the appointment of an American manager for the Great Eastern railway, has drawn attention to the methods by which such titled mediocrities as himself get into positions of great responsibility. The whole system of railway directorates, whereby a multiplicity of boards serves to disguise a virtual amalgamation of interests, needs investigation. Meanwhile, we are not sorry to see Mr. Henry Thornton take in hand the Great Eastern, for many are the American railroads that have been put into shape by British engineers. Free trade in talent is beneficial to industry.

IT has been suggested that the word 'dredge' is incorrectly used as a noun, and that 'dredger' should be substituted. We have not been unmindful of this apparently abnormal use of the word, but we have been inclined to support the irregularity for two reasons. In the first place, a large majority of engineers have adopted the usage, and secondly a distinction is afforded between the 'dredger' employed for deepening rivers or clearing harbours, and the 'dredge' used for raising gravel or other material containing valuable metal. Among analogies we may mention 'plane,' 'plough,' and 'stamp.'

EFFORTS to impress the Government with the desirability of official participation in the Panama-Pacific Exposition continue to be made. A petition signed by 350 members of the House of Commons has been presented to the Prime Minister, urging the re-consideration of the refusal of the Government to make provision for such a participation in that international celebration. We shall be greatly disappointed if this last appeal proves unavailing, for it was published on the same day as our morning paper gave us the text of the message delivered to the Senate of the United States by President Wilson when asking for a repeal of the Canal tolls. Small international courtesies, such as co-operation in the San Francisco affair, seem small indeed as we read an utterance so manly and so noble.

THE MARKET for molybdenum ores has been extended recently by the adoption of molybdate of ammonia as a preservative for nitro-cellulose explosives, more particularly those belonging to the cordite group. The effectiveness of this chemical in preventing the deterioration of the explosive in hot climates was discovered by a Japanese technologist, and its use has since extended to the war departments of other nations. Molybdenite is rarely found in large quantities, and most miners consider it as valueless. However, there is a demand nowadays for even low-grade parcels. Molybdenite is the most amenable to concentration by flotation of any mineral, and by a simple application of the selective principle it can be readily separated from pyrite, galena, or other heavy sulphide.

The Monroe Doctrine.

Recent events in Mexico have emphasized the fact that the Monroe doctrine is a one-sided arrangement. Not only is a Briton, William S. Benton, murdered by Pancho Villa, a commander of the so-called constitutionalist faction, but on the top of dilatory pseudo-diplomatic negotiations, the country that ought to be able to insist upon reparation is treated to an insolent tirade by Villa's chief, Venastiano Carranza. The United States plays the part of the dog in the manger. Unwilling to intervene, she prevents any other friendly government from taking proper action. We respect the American idea of freedom for development and detachment from European politics, but if this involves a political "keep off the grass" to all foreign nations having interests in Central and South America, then it ought also to include the acceptance by the United States of some obvious responsibilities. No European government desires to interfere at this juncture, but it has become apparent that if the American government is to be accorded a free hand in the Mexican impasse, it is on the assumption that the American government is prepared to exercise some measure of control over the bandits that pose as political reformers, whether in the north or south of Mexico. In short, the Monroe doctrine carries not only privileges, but corresponding responsibilities.

That policy is being put to the test. It is well that the political attitude involved in the Monroe doctrine should be understood. No phrase has been more twisted from its original meaning. Even the name is a perversion of fact. It did not originate from the shifty insincerity of James Monroe, but from the political genius of a much greater and nobler man: Alexander Hamilton. He held that the states, just formed into a republic, should abstain from participation in European politics, and, on the other hand, that the governments of Europe should be warned not to interfere with the development of the American nation and the expansion of its energies on the American continent. For enunciating this idea Hamilton and Washington were assailed by Jefferson and also, by one of the ironies of history, by Monroe himself. But it became the keystone of the foreign policy of the United States. It was wise and effective. Hamilton, however, would be moved to laughter to see to what extent his limitation has been perverted until it involves a dog-in-the-manger policy for the two American continents and for the unrestful isthmus that connects them. With the comprehensive assumption now entailed by the Monroe doctrine, the United States claims to keep any European power from gaining foothold between Lake Superior and Cape Horn, but it is not prepared to make good that claim by doing police duty over the misgoverned peoples of Spanish-Indian America. The Monroe doctrine has become a pretentious anachronism. If not, then let the United States fulfil its self-imposed duty of putting an end to the brigandage that masquerades as revolution in the neighbouring territory of Mexico. If the United States is unprepared to interfere when the life and property of European residents in Mexico are endangered by persistent disorder, then the government founded by Alexander Hamilton must permit the European governments to take concerted action with a view to ending the bloody misrule that has practically put an end to business and industry in the wide regions where British, French, and German capital and energy have become deeply rooted. In this connection, it is fair to quote ex-President Roosevelt, as good an exponent of American ideas as this generation has heard. In his autobiography he says, in regard to the Monroe doctrine: "It cannot in the long run prove possible for the United States to protect delinquent American nations from punishment for the non-performance of their duties unless she undertakes to make them perform their duties. People may theorize about this as much as they wish, but whenever a sufficiently strong outside nation becomes sufficiently aggrieved, then either that nation will act or the United States Government itself will have to act." All of which is plain common sense. As a strong nation, Great Britain can say that she has no thought to use the force of arms, but she is impelled to employ the compulsion of goodwill and logic, so that the United States shall not allow Britons to be murdered in a country over which it exercises political chaperonage. In short, the Monroe doctrine must be interpreted in the sense of national responsibility or recognized once and for all as a political mirage, the distorted image of the good sense enunciated by one of the greatest statesmen of the 18th century. The United States must make good its assumption of beneficent suzerainty over the American continents.

Northern Nigeria.

Northern Nigeria owes a good deal to Mr. J. Astley Cooper, who has become an accredited apostle of its industrial development by courtesy of the Royal Colonial Institute. On a recent occasion, February 24, he delivered an interesting address, containing not only figures and facts, but observations and suggestions that should prove useful to those engaged in the development of the region, more particularly the Government. As a mining country it is noteworthy that the export of tin has risen from 1470 tons in 1911, and 2605 tons in 1912, to 4062 tons, valued at £500,000, in 1913. Tin as used in these statistics always means a concentrate averaging about 72% metal. Further exploration and development has been hindered by share manipulation and accelerated by the introduction of motor-lorries, displacing human porterage. It only remains for the Government and the Niger company to come to some reasonable understanding in regard to the building and maintenance of roads. Good roads are worth more to a mining region than optimistic speeches by speculative directors. Meanwhile, the railway system is being extended, but the high freight-rates are a cause of continued exasperation, and constitute a heavy fine on the development of the mining districts. This is the story of all the West African Government railways, which have been managed under a policy suggesting the exploitation of the mining companies rather than the development of the mineral resources of a promising portion of the British dominions. We note that Mr. Cooper endorses the plea made by us recently for encouragement to the prospector, who, in Nigeria, is burdened with a fee exactly equal to the poll-tax levied on a Chinaman in Australia. Undoubtedly the Government is most unwise in discouraging the type of man who is the pioneer of mineral industry. As regards the latest mineral proclamation, this meets with Mr. Cooper's unsparing condemnation, and in this he voices sentiment among the company managers. Perhaps the annoyance expressed is accentuated by the fear of a further 2½% royalty, to be added to the 5% now payable to the Government. The feeling among the mine operators is that the Colonial Government and the Niger Company, which has profited so enormously and so unexpectedly from the tin discoveries, are in an unholy compact to make as much as possible out of the mines. Without a divining rod, we can guess that the authorities responsible for these unpleasant exactions consider it proper to penalize operations used so flagrantly for market operations of a shady character. We have no doubt—ceasing to guess—that the rigging of the share-market, so frequent in the Nigerian department, has obscured the legitimate and beneficent phase of mineral development. For this the earnest and honest enterprises suffer undeservedly. We can only hope that Anglo-Continental episodes will be rendered impossible, and that the basic purpose of tin-mining operations will become honourably apparent, so that those in control of the administration of Northern Nigeria will realize that they are dealing not with unscrupulous gamblers but with the industrial pioneers to whom the Empire owes its expansion to the four quarters of the globe.

Flotation Litigation.

After litigation lasting for six years the Minerals Separation flotation process has been declared by the highest courts of the British Empire, the House of Lords and the Judicial Committee of the Privy Council, to constitute an invention independent of anything done before. The actions were brought by the Ore Concentration company, the owners of the Elmore patents, the claim in the English courts being that their patents of 1898 and

1901 covered the use of oil in flotation processes and the application of acid for enhancing the selective action of oil for metallic and sulphide surfaces. The Chancery Court ruled against the claim that both patents covered the Minerals Separation process; the Court of Appeal ruled against the patent of 1898, but held that the patent of 1901 covered the use of acid for increasing the affinity of oil for metallic and sulphide particles; the House of Lords reversed the judgment of the Court of Appeal, and restored that of the Court of Chancery. Subsequently action was commenced in New South Wales. In this litigation, the oil claim was dropped, and the argument was centred on the use of acid for the purpose mentioned above. The Australian court was against the Elmores, who forthwith appealed to the Judicial Committee of the Privy Council. The appeal was heard in November last, but for some reason not disclosed a judgment was not given, and the case was re-argued last month before a larger court. The judgment of this court confirmed that of the Australian judge, the appeal being dismissed. With regard to the judgments of the House of Lords and the Judicial Committee of the Privy Council, we are free to say that many engineers have expressed surprise at their tone and methods, especially those who have known something of the earlier internal history of the practical development of the flotation idea. The judges of the House of Lords were unnecessarily offensive when they referred to tricky and subtle methods of preparing specifications and claims. The Judicial Committee of the Privy Council, during the hearings, appeared to be desirous of confining the arguments to the acid specification, and the impression gained by the audience and even by the lawyers engaged in the case was that the arguments in favour of the Elmores' claim were making an impression. The judgment upholding the Australian decision and maintaining the independence of the Minerals Separation process came, therefore, as a surprise to everyone, including the litigants on both sides. For the benefit of our readers we ought to explain that the Elmore patents of 1898 and 1901 referred solely to the original process wherein large bodies of oil were used to raise the metallic and sulphide particles, and that their patents of 1904 introducing their improved method known as the vacuum process were not cited in the legal arguments. No doubt there were good and sufficient reasons for not referring to the improved process, though, seeing that the chief Minerals Separation patent, granted to Messrs. Sulman, Picard, and Ballot, was of later date, namely, 1905, we think a mention of it would have been of value when surveying the broad field of flotation as distinct from the consideration of the narrower scope of the 1901 patent. As the Judicial Committee's actual judgment was based on this broad view, and not on the narrower arguments that occupied the greater part of counsel's time, an impression is created that the arguments and judgment were at cross-purposes. We are also left in doubt as to whether the five members of the Judicial Committee were unanimous, for the custom at that imperial tribunal differs from that of the English courts where each member gives his opinion. We have not the space to quote the judgment in full, but we can refer our readers to the issue of *The Financial Times* of March 7, where the full text appears. Suffice it to say that the Everson patent was held not to be an anticipation of the Elmore acid patent, but, on the other hand, that the Minerals Separation process was not an infringement of the Elmore patent, because it relied on surface tension and not oil for the flotation effect. The Elmore vacuum process depends just as much on surface tension as the Minerals Separation process; hence our remark that the judges should have included it within their broad view. Minerals Separation is also involved in litigation in America, and our San Francisco correspondent gives particulars of the arguments before the Circuit Court of Appeal. As we recorded in our issue of September last, Minerals Separation won their suit for infringement against James M. Hyde, who claimed that the Minerals Separation patent contained nothing novel, quoting the Everson patent of 1888 as an anticipation. The decision of this court is not expected until next month. It is impossible within the space of a short article to enter into the infinity of detail connected with the variations in the flotation processes, and to relate the views of the rival inventors. We feel bound, however, to say, from our knowledge of the investigations and negotiations of earlier days, that the Elmores have not received the kindest treatment by the law or the most generous consideration of those that are now their enemies.

Institution of Petroleum Technologists.

The inaugural meeting of the Institution of Petroleum Technologists was held on March 3 at the hall of the Royal Society of Arts in John Street, Adelphi. To judge by the large attendance and the serious enthusiasm of the audience, this new institution has been launched with every prospect of a successful and useful career. To have any other first president than Sir Boverton Redwood was unthinkable, for he is the doyen of the world's petroleum technologists. At the meeting he made a dignified statement formulating the aims and objects of the organization. The commercial element does not come within its scope. There is no desire to push the advantages of petroleum and its products in their applications as producers of power and light or as lubricants. The sole aim is to advance the scientific treatment of petroleum problems in their geological, chemical, and mining aspects, and to promote the better training of the future leaders of the petroleum industry. In fact, the institution is to be professional, and the aim is to secure a high level as regards knowledge, training, and reliability. The earnestness of the council is indicated by the fact that unusual care has been taken in settling rules and regulations and that the views of the city's leading solicitor and auditor have been sought as to the steps necessary to qualify for incorporation. After Sir Boverton's inaugural statement, three short addresses were delivered by Sir Thomas Holland, Mr. E. H. Cunningham Craig, and Mr. Vivian B. Lewes, respectively, the first being strictly technological and the other two in the nature of amplifications of the presidential statement. Sir Thomas Holland's address was devoted to the geometry of the various asymmetrical anticlines, and gave mathematical directions for tapping the crests of the successive oil-bearing beds. Mr. Cunningham Craig, with characteristic courage, said that the public and the financiers had to be taught the elements of petroleum geology and that petroleum mining must be put on a strictly business footing. Some of those present received a cold douche when he said that petroleum mining had to be placed on a securer basis than gold mining, "which at the best was only an attractive gamble," and the blow was not softened by the ripple of laughter that greeted his remark. This incident suggests that we have still much work to do in urging the regularization of business connected with metalliferous mining, and that the Institution of Mining and Metallurgy has a destiny to fulfil. Mr. Cunningham Craig clearly indicated the necessity for the geologist and the engineer being independent of the financier, and his own conduct has conformed to this ideal principle. Is it not possible for more of our metal-mining engineers to take this strong attitude, instead of being content to be merely the hirelings of the manipulators of markets? Mr. Cunningham Craig was also eloquent on the lack of opportunities in England for specialized training in connection with petroleum, and commended the action of Mr. John Cadman, professor of mining in the University of Birmingham, for his enterprise in establishing a course where geology, chemistry, and mining are taught from the point of view of the petroleum technologist. By means of this school it is hoped to train native talent for the multitude of posts now offered. At the present time chemical advice is sought on the Continent, and engineers and drillers are brought from America or Galicia. The concluding address, by Mr. Vivian Lewes, called attention to the chemical side of the subject, as affording the possibility of even greater prizes than the geology and engineering. The removal of troublesome sulphur compounds affords an important field for research, and the production of petrol products from petroleum by 'cracking' or otherwise is an equally attractive subject. Altogether the impression received by us as regards the tone of the meeting was distinctly favourable, and we look forward to the institution playing a useful rôle professionally and technologically.

The Institution.

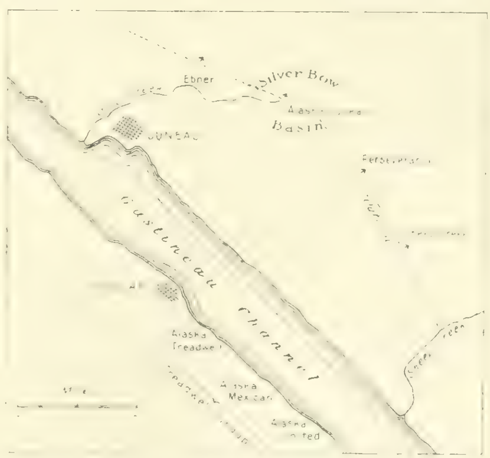
At the March meeting of the Institution two amendments in the constitution were made. The intent of the first was to except the mining of coal and the metallurgy of iron from the scope of the transactions, so as not to trespass upon the functions either of the Iron and Steel Institute or of the Institution of Mining Engineers. By the second amendment the corresponding members of council are dropped, so that the administration now consists of a resident committee of 12 ex-presidents, one president, one president elect, 6 vice-presidents, and 23 ordinary members of council, making 43 in all. The possibility of further changes was not discussed at this meeting, even such brief comment as was forthcoming being omitted from the formal minutes, which were ratified on the spot. In short, the object in view was not reform of any kind, but the completion of preliminaries likely to facilitate the application for a royal charter. This is well under way. We hope it may prove successful, for it should add to the prestige and authority of the Institution, enabling it to exercise disciplinary functions obviously much needed. The time will come, we hope, when the Council will be prepared, like the committee of the Stock Exchange, to pass censure on the acts of its members or even to expel them publicly when circumstances warrant drastic action. Such severe measures would be highly dangerous to the life of the organization if it had not already taken pains, by the limitations of membership, to lessen the chances of such untoward happenings. As Sir Thomas Holland said recently, in a presidential address at Manchester, "it is not unfair to say that the Institution of Mining and Metallurgy, largely through force of circumstances, has been more careful about its admission to membership than has been the Institution of Mining Engineers." Yes; it is not unfair to say it, for it is a fact. Membership in the sister society has been obtained readily, simply because it was "secured by easy access through one of the federated institutes" comprising the Institution of Mining Engineers. Much the same can be said of the American Institute of Mining Engineers, which, in the eagerness to obtain the financial support inherent to large membership, has accepted a large proportion of nondescript persons having a bowing acquaintance with the technology of mining and metallurgy. Since the recent upheaval, those in control of the American Institute have set to work to restrict election to men really qualified, and, in time, this policy will have its effect in raising the general standard. Without a high standard the membership in such technical societies means no more than the subscription to a technical periodical; and it has the blemish of being open to a suspicion from which the ordinary subscriber to a journal or magazine is free. Sir Thomas Holland said of the Institution that it "has so made its influence felt that its membership has become recognized throughout the world as a very definite standard of competence and honesty." That is a worthy compliment. But compliments carry with them an obligation, humorous and honourable, to be worthy of them. No mining society has been so careful in the election of its members, except, it may be, the Mining and Metallurgical Society of America, which has been so careful as to leave more qualified men outside than those admitted through its half-closed portals. The Institution has managed to avoid extremes; it has been reasonably selective without being unreasonably exclusive; it represents an official sieve that will hold only particles above a given size unless they happen, as sometimes is the case, to present themselves along the line of their biggest dimension. Owing to the lack of any government regulation as regards the use of such descriptions as 'mining expert,' 'mining engineer,' 'metallurgist,' and 'mining geologist,' it is highly desirable that some standard of knowledge and experience should be established. And nowhere more than in London, which is still the great financial centre of the world, and, as regards mining, the greatest incubator of mining enterprise. No regulations can be so effective as the selective and disciplinary authority of a chartered professional society recognized by the profession as a fitting exponent of its highest ideas of conduct. Such an authority is needed. We hope ere long to be able to announce that the Institution has been empowered to display its charter in the council-room of its new home in the City.

Alaska Mining.

To the present generation of miners the group of three mines on Douglas island has been the outstanding example of the successful exploitation of a big deposit of low-grade gold ore. The Rand is cited with variable confidence as the type of uniformity of yield over a wide extent of lode, but for profit wrung from economy of operation the Treadwell group is still the expression of triumphant mining engineering. The three Treadwell mines, namely, the Alaska Treadwell, Alaska United, and Alaska Mexican, all on the same lode, have yielded $54,000,000 in gold from an average return of $2·55 or 2½ dwt. per ton, at a cost of $1·50 per ton, to a depth of 1750 feet. Plans now being put into effect will increase the tonnage treated daily to 7500, together with a confident and systematic development to a depth of 3000 feet. This is being done under the direction of Mr. F. W. Bradley, who, when comparatively a boy, achieved wide distinction by making a record for cheap exploitation. So long ago as 1887 at the Spanish mine in Eldorado county, California, he mined and milled a soft orebody at a total cost of 63 cents per ton. The mine was an open-cut, and the reduction plant consisted of four Huntington mills, but the achievement was a faithful forecast of the bigger things he was to accomplish in mature manhood.

The Paris mine, which was the original of the Alaska-Treadwell property, was started in 1880, as the anti-climax of an excitement that made the Juneau district, on the opposite mainland, the centre of prospecting activity. At that time sundry exposures of gold-bearing quartz were found on the hillsides of Silver Bow basin, a glacial amphitheatre in the coast range; but the yield of precious metal was small and precarious, so that no mining industry of any importance could be founded at that time. Successive efforts to exploit these low-grade bodies of quartzose schist ended in failure hardly mitigated by an intermittent production of gold. Among the early ventures was the Perseverance, which became known in London through the financial activities of Colonel W. J. Sutherland. The story of this enterprise is of particular interest at this time, when it has become the basis for operations on a scale exceeding even those established by the Rand.

In 1895 Joseph T. Gilbert, of Gilbertsville, New York, became the owner of the Perseverance. He and his partners erected a 10-stamp mill and a wire tramway, so as to test the ore broken from the outcrop. The selected ore yielded $4 per ton. Desultory operations came to an abrupt end when, in 1899, a snowslide destroyed both the mill and the tramway. A year later Charles Pearce, a foreman from Treadwell, happening to meet Colonel Sutherland, at San Francisco, mentioned the mine to him. Whereupon the Colonel took the business in hand and subsequently drove an adit about 2400 feet long to tap the lode 1300 feet, on its dip of 73°, below the outcrop. This adit—the Alexandra Tunnel—cut 70 feet of $2·40 ore. In 1904 Sutherland met Mr. Arthur L. Pearse in London, and engaged him to make an examination, with a view to placing £100,000 in bonds with M. Achille Adam in Paris. Mr. Pearse reported favourably, but Messrs. Adam and Sutherland failed to agree on terms. In 1905 the firm of John Taylor & Sons sent Mr. J. H. Clemes to examine the mine, but he declined to confirm Mr. Pearse's appraisal of possibilities, for at that time an outcrop 4000 feet long and a point in an adit 1300 feet below represented the only data on which an estimate of 10,000,000 tons of ore had been framed. This, to a conservative man, seemed much too expansive. However, Sutherland raised some money in London, and, aided by Gilbert, proceeded to build a 50-stamp mill, which was completed in 1906, and helped to win a precarious profit. A yield of $1·90 per ton was obtained at a cost, in Alaska, of $1·20 per ton. Another unit of 50 stamps was added in the following year, 1907, and served to reduce the local cost to 93 cents, on a yield of $1·80 per ton. This work was done in the name of the Alaska Consolidated, which was merely a holding company for the Perseverance Mining Company, of New York. For five years this company operated on a narrow margin, the small profit disappearing in new equipment, London expenses, and litigation. In 1911 Colonel Sutherland died. He owed his title to having been on the staff of a Cuban governor and had many of the characteristics of the 19th century mining promoter: expansive and expensive, florid and flamboyant, persuasive and predatory. Just before his death serious litigation had been started in Alaska on the initiative of Mr. Louis Shackleford, who had quarrelled with the Colonel over a



game of poker, and had vowed to get even. He owned apex rights through a claim called the Groundhog, which covered part of the wide outcrop, and controlled sundry other claims on Sheep creek along the strike of the lode. This Mr. Shackleford, with Mr. B. L. Thane, acquired the ground on which the tailing from the Perseverance mill discharged and thus caught Sutherland in a cleft stick. On the death of the latter, these two, with Mr. W. P. Hammon, of San Francisco, approached the English shareholders with a view to a general compromise and eventual amalgamation of interests. This was effected finally in 1912, the Alaska Gastineau Gold Mining Company being registered in New York to acquire the various conflicting properties.

Thereupon bonds were issued through Hayden, Stone & Co., of New York, for the purpose of raising $1,250,000 working capital. As soon as this had been accomplished, the promoters, Hayden, Stone & Co., sent Messrs. D. C. Jackling and A. F. Holden to examine the mine. They reported enthusiastically and recommended the provision of $4,500,000 for development and equipment, the latter to include a mill of 6000 tons daily capacity and a hydro-electric power-plant. The capital required was raised by issuing 614,700 shares at $10, the remaining 135,300 shares, out of a total authorized capital of 750,000 in $10 shares, being held in reserve for general purposes and to acquire the outstanding minority stocks of the two original constituent companies. This issue was made in July 1912, $5 per share being paid on allotment and $5 a year later. Since then the shares have risen to $24. Albert F. Holden died in May 1913. The scheme outlined by the new control was an enlargement of that originally suggested by Mr. Pearse. His first milling unit was to have had a capacity of 2000 tons; Messrs. Holden and Jackling proposed to start with 6000 tons daily. Mr. Pearse estimated a stoping-width of 60 feet, averaging $2·20, to be worked at a cost of $1·25 per ton; his successors expect to stope an average width of 70 feet of ore averaging $1·50, at a cost of 75 cents per ton. This estimate was not based upon ordinary sampling, which in a lode of this size and grade is impracticable, but upon the yield from 600,000 tons taken from three different large stopes. The main orebody was estimated to be 4500 feet long, the plan of development including the driving of an adit from Sheep creek on the lode at an average depth of 2200 feet below the outcrop, or about 700 feet deeper than the old workings. This has now been done. The adit, 8 by 10 feet in section, was driven as much as 570 feet in one month, namely, last June. The confidence necessary for such comprehensive operations was given by the records of the mine, the apparent continuity of the big orebody, and the successful results obtained at Treadwell. On the evidence available at that time—early in 1912—it was assumed that 50,000,000 tons of ore were "definitely indicated," and on this basis the property was deemed a "bargain" at $12,000,000, provided that the necessary capital was available. Eventually it is expected to treat as much as 20,000 tons per day or 7,000,000 tons per year. This compares with the biggest consolidations on the Rand as follows: Randfontein Central, 8000 tons; Crown Mines, 6000 tons; and the East Rand Proprietary, 5500 tons per day.

Meanwhile an enterprise of similar character was being developed on the Alaska Juneau mine, which adjoins the old Perseverance on the north. Here the engineers are Mr. Bradley, to whom reference has already been made, and Mr. Robert A. Kinzie, the resident manager of the Treadwell mines. The late Capt. Thomas Mein was interested in this property, and with him at one time were associated Wernher, Beit & Co., but the interest of the latter has passed from them. Operated during the short summer months only, the Alaska Juneau earned meagre profits from a $1·25 ore, and could hardly be regarded as a winning venture. It became evident that only exploitation on a large scale with a big mill near tide-water could wrest an assured profit from this wide lode of low-grade ore. Both at this mine and the old Perseverance the heavy snow-fall and severe climatic conditions prevented economic operations in winter; it became necessary to abandon the attempt to open the mine from surface and, instead, to pierce the lode by an adit from Gastineau channel, the strait—a mile wide—dividing the mainland from Douglas island. Thus the engineers of both the Alaska Gold Mines and the Alaska Juneau projected deep-level adits connecting the workings underground with big mills on the shore. The Alaska Juneau adit is 6538 feet long to the point where a rise extends vertically to the surface, 800 feet overhead, and on the hanging-wall side of the lode. If driven in the lode itself to its outcrop this rise would be 2000 feet long. By the time this connection is made the first milling unit of 30 stamps will be ready to treat some of the richer ore, so as to contribute toward further development, and at the same time another 10-stamp mill will begin a series of crushings to test the ore exposed in the workings and to ascertain the best system of metallurgical treatment. The lode cut by the adit is 500 feet wide and averages \$2 per ton. This yield is better than that from the surface workings, but it is believed that it will be maintained for "considerable distances both longitudinally and vertically," for a 30-stamp mill has been working for 5 months each year for 15 years on ore extracted from open-cut workings. It is now estimated, by Mr. Bradley, that an average recovery of \$1·45 per ton can be obtained from an output of 6000 tons per day, at a cost of 80 cents, to be decreased when the operations are matured to a daily output of 12,000 tons.

As affecting both of these undertakings, it may be stated that Mr. J. R. Mitchell, the former superintendent of the Perseverance and a particularly capable man underground, applied the caving system successfully and indicated that 100 tons of ore could be broken per machine-drill shift, as against an average of 31 tons in the Treadwell mines. This difference is due to the unlikeness of the lodes, that in Silver Bow basin being characterized by quartz lenses and stringers in schist with a distinct parting along the foot-wall, while that on Douglas island is a tough diorite penetrated by quartz veins without any selvage on either wall. The Juneau-Perseverance lode-matter, when broken, will disintegrate on exposure to the air, so as to crumble into pieces small enough to pass down the chutes and into the tram-cars, while the ore of the Treadwell lode, after being blasted, has to be drilled and dynamited into smaller pieces and reduced further with sledge-hammers. The chief items of cost on a basis of 6000 tons daily, compare as follows:

	Treadwell	Silver Bow
Mining	95	40
Milling	25	20
Concentrate treatment	8	7
Construction, etc.	12	13
	\$1·40	\$0·80

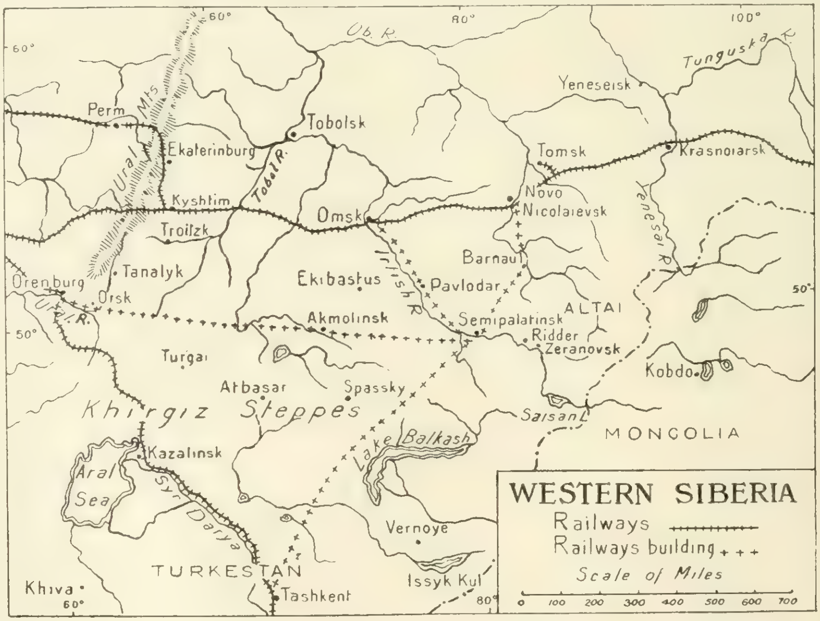
The main difference is in mining, this being due to the fact that development work, stoping, and general expense together amount to 72 cents per ton at Treadwell, and only 24 cents at the two big mines on the mainland. Again, tramming, hoisting, and pumping are estimated at 23 cents in the one case, and only 16 cents in the other. These figures would not be worth quoting in this Magazine if they were taken from an ordinary prospectus or even from a report by an inexperienced engineer; coming from Mr. Bradley they have a technical value and an economic interest not to be gainsaid.

Adjoining the Alaska Juneau on the north another big enterprise is being developed, on the Ebner properties, by the United States Smelting & Refining Co. Orebodies of similar character have been exposed, and arrangements have been made to equip and operate the mine on a scale similar to the two other companies southward. The Ebner was worked for 15 years by a man of that name, who proved the existence of large reserves of ore yielding \$1·80 per ton for a width of 60 feet. An adit now being driven will cut the lode at a depth of 1200 feet below the surface.

If the plans outlined above are put into effect, as seems certain, the Juneau district will yield \$20,000,000 gold per annum from the treatment of 12,000,000 to 15,000,000 tons of ore. Undoubtedly the establishment of such an industry in this part of Alaska will lead to intensive exploration all along the schist belt of the coast range. It will involve an advance in the technique of mining engineering as applied to big bodies of low-grade ore, and it will be accompanied by sundry innovations in metallurgical treatment, which, speaking broadly, will be modelled more on American disseminated copper practice than on that of gold milling in California, Australia, or South Africa.

The Altai.

The recent activity in Russian shares signalizes the approaching revival of industry in a historic mining region, the Altai. This part of Siberia, watered by the Ob and the Irtish, is reserved in large part as 'Cabinet' land and has been operated by the Crown. Another similar tract lies near Nerchinsk, in the Amur watershed, in the one case 175,000 square miles and in the other 35,600 square miles being sequestered from public enterprise. The districts were both mined for the base metals, chiefly lead, long before the Siberian railway was laid across the continent. At that time these domains were entirely isolated from the rest of the world; labour was cheap, when not forced; and a local market at high prices was available for the products of local industry. As soon as the trans-continental railway was built, the price of labour was multiplied fivefold, and imports killed many forms of local industry. Factories and mines were closed-down, for while the railway created competition from the outside, it did not help mining in those parts of Siberia still without adequate means of transport. Thus at first the railway was not an obvious blessing to small-scale mining, for the increased cost of labour and the loss of a local market killed the effort to exploit silver-lead ores profitably. Now a new era has begun, namely, the construction of branch lines of railway or other well organized means of transport helpful to operations on a large scale, and enabling the export of metallic products to distant parts of the Russian empire. Moreover, supplies of fuel have, or will, become available for smelting operations. That is the story of the mines already financed in London, such as the Spassky, Kyshtim, and Atbasar, where the introduction of suitable transport has permitted the establishment of large-scale enterprise. The more recent interest in the mines of the Altai is due to parallel causes. Ten years ago the Prince Alexander of Thurn und Taxis obtained a concession of 20,000 square miles on the Cabinet lands of the Altai, where mining was an active industry more than a century ago. The concessionaire was unable to exploit his



concession, mainly because the lack of transport and fuel, among other factors, militated against operations on a modern scale. Being compelled to decrease his responsibilites, he dropped the central part of his concession. This is the part now controlled by the Russo-Asiatic Corporation, the chief mine being the Ridder. On the northern portion of the original concession is the Zminagorsk group of mines, and at the southern end is the Zeranovsk, a mine that at one time was the most important in Siberia, being connected with a Government school of mines that did good service in training superintendents and foremen for Russian requirements. These northern and southern portions of the original concession have been transferred, on terms, to the Russian Mining Corporation. The whole of the concession is on the east side of the Irtish, the river forming the western boundary, and also the chief means of transport to the Siberian railway at Omsk. For the six or seven months of summer, steamers ply between the railway and Lake Saisan, near the Mongolian border. These steamers pass the concession, 1000 miles from Omsk, and furnish an outlet for the butter and eggs, of which there is a prolific production in the fine agricultural land of the Altai uplands. But river transport does not suffice for mining on a big scale, nor will charcoal derived from the dwindling forests serve for large smelting operations. The remedy is at hand, and the knowledge of it has sent enterprising financiers to St. Petersburg and mining engineers to the Altai. The construction of a railway was begun last year from Novo Nicolaievsk on the Siberian railway southward to Barnaul, thence to Semipalatinsk, with a branch line to Kaltshugina, where a French company has started to exploit valuable coal measures with a view to shipping coke to the Ural, where it will replace the English coke and the local charcoal used in important iron and steel industries. From Semipalatinsk a line will be built north to Omsk, another west to Orenburg, and a third south to Tashkent, thus making Semipalatinsk a great railway centre and stimulating the development of a most promising portion of Siberia. The rail connection between the coal mines and Semipalatinsk will, of course, aid the mining industry of the Altai enormously. To render this aid direct, it will be necessary to build a short branch railway from Semipalatinsk south along the Irtish, but this, if several powerful companies are to take a hand, should not be long delayed.

Prospecting.

Our friend the *Mining and Scientific Press* has shown commendable enterprise in eliciting the opinions of a number of well known mining engineers on a most interesting subject, the decadence of prospecting. We have read these expressions of opinion with keen interest, knowing the personal equation applicable to most of the individuals quoted. On the whole it is made clear that plenty of money is still available for prospecting wherever the evidence is attractive; it is generally agreed that Government subsidies or any form of direct financial aid is undesirable; that the spirit of adventure no longer drives the explorer far afield as of yore; that most of the easily accessible exposures of ore have been found; and that the prospecting of the future will entail a larger application of technical knowledge. Many of these American engineers make satirical references to the bumptiousness of the Forestry bureau as hindering prospecting on the National domain, while others consider that the use of the Post Office for the sale of shares in fraudulent mining companies has tended to raise the price of prospects to prohibitive figures. One discerning commentator points to the contradictory rulings of the Land Office as introducing an unnecessary element of insecurity, while another asserts that the mining law, requiring discovery before location, is a serious deterrent to prospecting. On the other hand, it is gladly acknowledged that the Geological Survey and the Bureau of Mines are both aiding mineral exploration. Of course, the Survey, by means of maps and reports, has given the miner invaluable aid from its very beginning under Clarence King in 1879. The topographical and geological maps, followed by underground plans and sections of detailed geology, have furnished the intelligent prospector a chart that has led to the discovery of numberless orebodies. Beside this written assistance, official geologists have not hesitated to gave verbal advice to such earnest investigators as have cared to come to them in the tent or the hotel of the young mining settlement. The attitude of the Survey has been that of the open hand. Such technical guidance has become increasingly necessary. The day of the illiterate digger is gone ; the orebodies that outcrop in plain sight have mostly been found ; the search for mineral wealth has passed to the man who can make scientific inferences. The economic geologist has arrived. In consequence of the rapidity and ease of modern transport, the discovery of a single promising outcrop is followed by the 'location' or 'denouncement' of the entire surrounding area for miles, excluding the old-time prospector at once. Then one or two resourceful companies, by option or purchase, acquire large tracts and set to work to test the ground under the direction of experienced mining geologists. Such companies still believe it to be cheaper to buy eggs and to hatch them than to buy hens. They have learned that the buying of ore reserves is not a sure thing, while it also absorbs large lumps of capital.

We doubt whether the old spirit of adventure is dead ; it has passed from the prospector to his next in command, the mining engineer. In the most remote corners of the earth he is to be met. When a cablegram reaches London with the news that a rich find of ore has been made anywhere from China to Peru, from Siam to Alaska, at once syndicates are formed and technical leaders are forthcoming. No ; it is not that. The geographic possibilities are becoming exhausted ; the virgin areas are becoming few. The cream has been skimmed from the milk. Many of the great finds of the past have been purely accidental ; a prospector has stubbed his toe against the top of a treasure-vault, a digger has awakened to find his rocky pillow rough with gold. Discoveries as fortuitous are common in the records of mining. Of necessity they are becoming more and more infrequent. The gold-quartz outcrop that catches the rays of the setting sun and hits the explorer in the eye, as it were, has been dynamited, crushed, and milled long ago. It remains to seek for the orebodies that are covered by the jungle of the tropics or the tundra of the sub-arctic regions ; to find those that have been leached at surface or faulted out of their orderly sequence ; to uncover the low-grade deposits that the old prospector disdained and to re-open the old workings in which he lost his geologic way. Here is where we get the true answer to this inquiry. The day of the prospector is passing because his success depended upon the discovery of ore so rich that he and his comrades could work it. Now that the superficial rich deposits have become rare he can only expect to find deposits so low-grade as to be unprofitable to his own limited means of exploitation. In other words, he can expect only to find something that he cannot exploit, and which, therefore, can bring him gain only by the sale of it to those that have the capital and skill to do so effectively. He finds something that is of no use to him ; hence he is at a great disadvantage in selling it to those to whom it is of use. In other words, his independence is gone. He is dependent now on the mining engineer who scouts for the capitalist. No longer independent, the prospector has lost his old spirit, that great spirit of adventure that made him eager to cross the range, to climb above timber line, to invade the desert, to penetrate the very heart of the untrodden wilderness. No longer does he hear the call of the wild :

> "Something hidden. Go and find it
> Go and look behind the ranges—
> Something lost behind the ranges.
> Lost and waiting for you. Go."

The Exploration Company.

As usual, Mr. R. T. Bayliss made an interesting speech when presiding at the Exploration Company's annual meeting. We note with particular interest his remarks on the copper industry. In the early days of his company, when it was prominent in Anglo-American enterprise, its financial energies were centred on gold mining, which was then the chief subject of joint-stock finance in London. Since then the decline of the Rand, the diminution of opportunities in the Rocky Mountain region, and the disorders in Mexico have tended to restrict expansion in the exploitation of gold ores, while, concurrently, the growth of copper mining has progressed in remarkable fashion. As we have suggested before, it is curious that the big South African corporations should have failed so signally to participate in the development of the magnificent copper enterprises that have made the Utah Copper, the Nevada Consolidated, the Miami, Ray, Chino, Braden, and Chuquicamata synonymous with the skilful application of money and brains to the winning of metal. The Exploration Company, through its representative at New York, Mr. Philip L. Foster, has accepted some of the opportunities offered, and these, despite one fiasco at Butte, have proved remunerative. Now Mr. Bayliss announces a participation with the Guggenheims in the Chile Copper Company, which operates the Chuquicamata mine in Chile, one of the most remarkable copper deposits ever uncovered by the miner's pick. The ore assured is stated authoritatively to amount already to 200 million tons, averaging 2% copper. This ore is mainly brochantite, a basic sulphate soluble in water, so that it can be leached successfully. Our New York correspondent has referred to this enterprise frequently. It is most interesting. Good management is assured under the direction of Mr. Frederick Hellmann and the consulting advice of Mr. Pope Yeatman. The financing of the company, in May 1912, was done on an expansive scale, no less than $15,000,000 in 7% convertible bonds being issued to provide funds for development, on top of an issue of $95,000,000 in ordinary shares. Interest charges alone will consume the profit on a gross production of $2,000,000 worth of copper. It is estimated that a production will be made of 120 million pounds of copper at 6 cents per pound laid down in European ports ; this is equal to 53,500 long tons of metal to be delivered at £28 per ton, suggesting, if not indicating, a profit of £2,000,000 per annum at an average price for copper. To give point to this participation of his company, Mr. Bayliss gave some interesting statistical notes, of which we need only say that in the main they seem to us perfectly sound. Briefly, the facts are these: the production of copper for 25 years has been absorbed by the consumption ; no reason exists for anticipating a decrease of consumption, which progresses steadily and seems destined to undergo acceleration with the world-wide demand for the metal in most of the industrial developments now obvious ; moreover, copper mines are wasting assets, and the ones now being opened up, like the Chuquicamata, will only redress the loss of those approaching exhaustion, like the Calumet & Hecla. Meanwhile fluctuations in the price, such as have disfigured the records of copper mining on severa occasions within living memory, are less likely, owing to the geographic distribution and colossal dimensions of the industry, now firmly established on the foundation of one of civilization's vital necessities.

PERSONAL

A. W. ALLEN is expected from Rhodesia.

CHARLES A. BANKS has returned to British Columbia.

J. A. BARTRUM has been appointed lecturer on geology in the University College, Auckland, New Zealand.

J. MACKINTOSH BELL sailed for Canada on February 28.

CHARLES P. C. BERESFORD has gone from Mexico to be assistant manager at the Prestea.

J. NORMAN BULKLEY, having resigned as consulting engineer to the General Mining Corporation, is now in London.

VALENTINE E. DE CARTERET has returned from the French Congo.

PETER CLARKE is on his way to Northern Ontario.

L. MAURICE COCKERELL left London on February 13 for Uruguay, to be away three months.

J. G. CUNNINGHAM is on his way to Montevideo.

T. LAUNCELOT DAWSON has gone to Anatolia.

E. D. MCDERMOTT is going from Tanalyk to the Altai, instead of returning to London.

A. E. DRUCKER has opened an office at 62 London Wall.

A. E. FIREBRACE has been appointed manager of the Limoro tin property, Nigeria.

R. M. GEPPERT has returned from the Esperanza mine, Mexico.

ADOLF VON GERNET, of St. Petersburg, was here during February.

HARRY D. GRIFFITHS has returned from Burma.

NOEL GRIFFIN is on his way to Bulawayo.

ANDRE P. GRIFFITHS and ERNEST A. MANNHEIM have dissolved partnership.

J. A. L. HENDERSON has returned from Canada.

NEWTON B. KNOX has returned from Colombia.

E. A. LANG, representing Arthur L. Pearse & Co., sailed for Dutch Guiana in February.

FRANK LANGFORD is in the Malay States and is intending to visit the Philippine islands.

G. F. LAYCOCK has returned from Asia Minor.

ARTHUR LLEWELLYN has recently made an inspection of the Tasmania gold mine for John Taylor & Sons.

FRANK LORING has arrived in London from Kirkland Lake.

STANLEY H. DE LA MARE has returned from Rumania.

G. MACFARLANE has been appointed manager of the Mawchi tin and wolfram mines, and left for Burma on March 12.

GODFREY E. MORGANS has returned from Colombia, where he examined iron and coal deposits.

HORACE G. NICHOLS, of Bainbridge, Seymour & Co., is in the United States.

W. D. PATERSON has left for the Socorro mine in Honduras to take charge of the cyanide plant.

L. E. B. PEARSE has returned to Northern Nigeria.

The firm of PEARSE, KINGSTON & BROWNE has been dissolved.

F. DANVERS POWER left for Australia on February 16.

NORMAN DANVERS POWER has returned from the Philippine Islands.

CECIL RAE, of Ipoh, Perak, is visiting Australian tinfields.

ROBERT M. RAYMOND has been visiting the Braden copper mine, in Chile.

WILLIAM RICH has been appointed chairman and managing director of the Namaqua Copper Company.

H. P. ROBERTSON, the manager of the Bisichi, is home.

A. L. ROBINSON has gone to Nigeria.

S. A. R. SKERTCHLY is on his way to Madagascar.

O. J. STEINHART is visiting Spain and Portugal.

LESTER W. STRAUSS is at Valparaiso.

E. HOGAN TAYLOR has been appointed superintendent of the Great Cobar and sailed for Australia on February 16.

SCOTT TURNER is due from New York on his way to Tromsoe, Norway.

HAROLD TURRELL has been appointed on the engineering staff of the Amalgamated Tin Properties of Nigeria.

E. C. VIGEON has resigned from the management of the Spassky copper mine, and is due in London.

ERNEST WILLIAMS has gone to Paramaribo, Dutch Guiana.

L. A. WOMBLE, manager of the Geduld Proprietary, is in London.

Royal School of Mines.—The 41st annual dinner of the old students and the first annual dinner of the R.S.M. Association will take place on Wednesday March 18 at the Café Monico, Piccadilly. For tickets, apply to the Hon. Secretary, T. A. Rickard, at 724 Salisbury House.

SPECIAL·CORRESPONDENCE

JOHANNESBURG.

The Life of the Rand.—It is never too late to ascend, and by publishing its evidence before the Economic Commission the Chamber of Mines has gone up one in the estimation of the public. It should have made its frank statement long ago, for in the absence of authoritative refutation investors had no option but to believe the semi-authoritative and ridiculously optimistic estimates thrown at their heads from time to time when things wanted bucking up. Now, thanks to a wave of enlightenment, it is known that in five years a gradual slackening will set in and that in 17 years production will be only one half what it is today. One figure in the evidence that deserves comment is the arbitrary maximum vertical depth line of 7500 ft. The Chamber here slavishly followed the Mines Department, an easy way of avoiding a difficulty, but one betraying little originality of treatment. As a matter of fact, it would be difficult to discover an engineer of experience who would exhibit any confidence in his ability to solve all the problems that would confront exploitation at that depth, even if he treated with contempt the now generally accepted argument of decrease of richness in depth. Most engineers would cheerfully sign their names to a prospectus were 6000 ft. taken as the limit, a few would 'chance their arm' with 7000 ft., but 7500 ft. would require a person who could sleep through anything. Geologists, with the fearless logic of their race, are quite happy down to 10,000 ft., but then they are scientists not miners, and their zone of flowage is a poor substitute for a shaft. Another point calling for comment is that the value of undeveloped ground has been arrived at by applying without modification the average data disclosed in the last 1000 ft. of all the workings throughout the length of each mine, no allowance being made for alteration of yield. This method assumes that there is no impoverishment in depth, an assumption that Messrs. Hellmann and Webb have shown to be a fallacy. The whole evidence is put in a most interesting form and points out ways of salvation that deserve careful study, but it can nearly all be boiled down into the injunction: reduce working costs, and in the words of the apostle, all these things shall be added unto you.

Reduction of working cost seems almost certain to be rendered practicable before long by the removal of the colour bar, and strangely enough the famous white labour protagonist, Mr. Cresswell, has become the chief influence at work in removing it. At the Labour Congress he introduced a motion, which, though ingeniously worded, really amounted to an acknowledgment of the right of coloured workers to belong to the trades-unions of the aristocratic Transvaal and Orange Free State, as they already do to the more democratic trades-unions of the Cape. There the bulk of the skilled work is done by coloured men, and they have votes. They naturally object to give their vote in favour of a party that treats them as labour equals in one province and as labour rivals to be kept under in another. As one congressman aptly put it: "In Natal and the Cape these coloured workers had votes; then why ostracize them from giving those votes to the Labour party?" Following on this momentous decision it would be impolitic for the Party to protest if natives were given skilled work to do in the mines of the Transvaal, because strenuous objection on their part would alienate the Cape coloured voter and strengthen other political factions at the expense of Labour representation. The only other obstacle of importance is the mining regulation restricting coloured workers to unskilled work, a regulation that legislation can easily remove should Parliament deem it advisable to unify the enactments of the Union in this repect. In any case, the present artificial arrangement is so logically inconsistent and so economically disastrous that nothing can prevent its eventual collapse.

The Class War, which the vicious group of Transvaal revolutionary Socialists attempted to initiate, was fortunately prevented by a firm Government, and the country saved from bloodshed and economic disaster. The strike outrages of last July opened the eyes of the authorities to the dangerous nature of the forces at work, and brought home to all decent citizens the ludicrous absurdity of allowing themselves to be trampled under the feet of a little knot of imported agitators. Martial Law was proclaimed half an hour after the declaration of war by the Trades Hall junta, and its promulgation had a remarkably evaporative effect upon the bravery of the *sansculottes*. The mobilization of the Defence Force was carried out with a celerity only equalled by the dramatic swiftness with which thousands of bearded burghers mounted on wiry brown horses appeared on the scene from out of the backveld. The educated but apathetic residents of the town and suburbs, following the example of a wide-awake Government, organized themselves into police patrols, thus greatly assisting the authorities by releasing the ordinary police for special guard duties. So thorough were the precautions taken and so hearty the response to the call for protection to life and property that the situation was absolutely in hand from the very start, and all danger of anarchy at an end. Excepting a few dynamite outrages, which caused little damage and no loss of life and which served to demonstrate how needful were the measures adopted to preserve order, nothing occurred to disturb the salutary if somewhat monotonous restrictions imposed by Martial Law. As every one had to be indoors from 8 p.m. to 5 a.m. and all the bars were closed, a godly, righteous, and sober life became the realized standard of the entire community. Apart from the vote-catching histrionics of a few parliamentary sham-fighters the deportation of the nine principal conspirators has met with general approval. All thinking people recognize, and are prepared if necessary to show their recognition in a practical manner, that the government handled a dangerous emergency remarkably well and set an example, which other governments might well follow, of how to effect the bloodless removal of the cancerous growth of Syndicalism. The mines are already benefitting from the frustration of the social revolution. Previously, the truculence of a certain section of the workers made it dangerous to sack an incompetent or a loafer for fear of bringing on a strike; now the slacker is no longer able to dictate to the foreman but must get down to it or quit. This wholesome change makes for better discipline, better work, and lower costs.

A new drill, according to London rumour, has been evolved that will increase Rand dividends as much as 10% on some mines. Rumours of a similar nature were current at the time the Gordon drill was in fashion, but the scrap-heap soon silenced them. Considering the necessity for perfecting machine-drilling in order that the industry may be as independent of labour fluctuations as possible, there is every incentive to hasten developments in machine-drill design and practice with the utmost speed. Progress, it is satisfactory to note, is being steadily made, if at a disappointingly slow rate. Two drills that are accomplishing promising performances just now are the Atlas and the Water-Leyner. They weigh about 70 lb. and are easily handled. But to jump to the conclusion that because a drill gives encouraging results its employment will markedly reduce costs and increase dividends is merely hysterical nonsense. A notable improvement will be effected without doubt, but it will be made in the natural way of evolution, by a slow advance from one little improvement to the next, and not by a sudden sensational jump.

Crown Mines—Robinson fusion has been knocked on the head in such a sudden fashion that one is compelled to wonder whether the collapse could really have been brought about by a few disgruntled Robinson shareholders. Past history certainly records the successful opposition the Pullinger interest made to the absorption of the New Heriot by the Nourse Mines, but in the case under criticism the name of Hyman is the only one that has come to the front, and that is not a name associated by Rand people with any great amount of power in financial circles. Speculation is rife, and the matter should be cleared up if only to settle the bets. The circular states that the comparative values of both mines were agreed by competent engineers, but there is no mention of an independent engineer having been called in to check the agreed valuation. This would seem the proper course to adopt in important transactions where large sums are involved and many interests have to be safeguarded. In face of what looks like a vote of no confidence, the board of the Robinson company has resigned. It is just as well that mergers should not have it all their own way, for sooner or later the thing will develop into a bad habit. The plain South African man is already beginning to regard the word 'amalgamation' with the same disfavour as his American brother regards the word 'trust.' He reads into it something soulless and sinister. In all future deals of this nature it would be well to adopt the following procedure: First the routine engineers in the employ of the contracting parties will make their reports, these will then be dealt with by an independent engineer in a covering report, and, finally, the Government mining engineer will be asked to give his imprimatur.

Tweefontein Colliery is to be the seat of a large electrochemical works, an elaborate plant being now in course of construction to the order of Messrs. Harper Bros. & Co. The equipment comprises a Mond producer-plant to deal with 400,000 tons of coal per annum,

UNDERHAND STOPING ON THE MAIN REEF OUTCROP.

boilers fired with producer-gas, and a steam-turbine plant of 15,000 kw. The chemical plant is designed for an annual production of 22,000 tons of ammonium sulphate and 10,000 tons of tar and distillates. Tests with this coal under working conditions in similar producers show a yield of 119 lb. of ammonium sulphate per ton. The power-plant will be connected with the Rand electrical reticulation by means of a 50-mile 80,000-volt transmission line. This new undertaking affords evidence that the commercial value of the magnificent coal deposits of the Transvaal is at last attracting definite attention in manufacturing quarters, a recognition of possibilities largely due to the pioneer work of Lewis & Marks at Vereeniging.

The Premier Diamond Mine flourished exceedingly during 1913. Comparative figures are as follows:

	Year ended October 31, 1912	Year ended October 31, 1913
Loads (16 cu. ft.) washed	9,707,098	10,434,680
Carats per load	0·205	0·202
Value per carat	£1. 0s 5d.	£1. 2s. 2·1d.
Value per load	4s. 1·6d.	4s. 5·7d.
Cost ,, ,,	2s. 4·8d.	2s. 6·7d.
Profit ,, ,,	1s. 8·8d.	1s. 11·1d.
Total profit	£733,000	£1,003,000
Dividend on deferred shares, amount	£240,000	£400,000
Dividend on deferred shares, percentage	600%	750%

The capital of the company is only £80,000, divided into £40,000 in deferred shares of 2s. 6d. each, and £40,000 in preference shares of 5s. 0d. each with a fixed rate of interest of 250%. Before the shareholders receive anything the Government is paid 60% of the actual profit available for dividend. The balance of cash assets on October 31, 1913, amounted to £516,000, in which is included a trading fund of £300,000 and an emergency fund of £100,000, in both of which the Government has a 60% interest; and up to the same date the company had washed 65,306,976 loads of diamond-bearing ground, recovered 16,455,704 carats of a value of £14,960,004, and after meeting the Government claim paid out to shareholders £2,160,000, or 2700% on its capital! In colloquial phraseology such a return may be described as 'quite useful,' and it seems incumbent to employ the expression 'beyond the dreams of avarice.' But no matter how brilliant the past has been its dazzlement must not be allowed to confuse any estimate of the future. An inspection of the data of recent years shows that the yield per load is steadily decreasing and the cost per load increasing, an adverse combination which would have exercised serious effects on profits had it not been that the rapid advance in the price of diamonds generously counterbalanced any such objectionable tendency. If we take a yield of 0·200 carat per load, a value of 15s. per carat, and a cost of 3s. per load, the profit disappears; and the first of these eventualities is certain, the second quite to be expected in a commercial depression, and the third within hail judging by the continued rise in working cost since 1907. The mine is now developed to the 310-ft. horizon, above which a reserve of ground approximating 25,000,000 loads or two years supply is standing. The average depth of the workings is 290 ft., an increase of 31 ft. during the year. To what depth the system of the open working can be carried it is difficult to estimate. Conditions are certainly favourable to open working. The pipe is elliptical in shape with a length on the major axis of $\frac{1}{2}$ mile and on the minor axis of $\frac{1}{3}$ mile, and the vertical felsite walls stand remarkably well. Optimistic engineers assert that it will be feasible to continue as at present to a depth of 1200 ft., but it seems probable that, in order to safeguard workers from falls of rock, underground working will have to be introduced near the walls at about 500 ft., and the whole area mined by an underground system before the workings reach a depth of 1000 ft. In mining the ground machine drills are now largely used and 2000 natives have been saved by their use. The ground is not floored but put through breakers and rolls at once. During the year, 879 white men were employed with a wage bill of £261,816, and 14,548 natives at a cost in wages of £611,226. The average earning per native per day was 3s. 0·13d., the natives catering for themselves. The lithological constitution of the blue ground is much the same as at Kimberley. The bulk of it is made up of large and small pseudomorphs after olivine; and of the common megascopic kimberlite accessories, ilmenite is abundant, enstatite fairly abundant, pyrope and diopside rare.

TORONTO.

Porcupine.—The reports submitted at the third annual meeting of the Hollinger, held at Montreal on the 2nd inst., were of a decidedly optimistic character. President Noah A. Timmins, in a brief survey of the year's operations, stated that the treatment of 138,291 tons of ore had yielded a profit of $1,628,113. After writing off upwards of $120,000 for depreciation, the surplus carried forward was $688,462. The report of the general manager, P. A. Robbins, dealt at length with the matter of ore reserves, which were estimated at 845,000 tons, of the average value of $13·71 per ton, or a gross gold value of $11,604,800. The estimate of the previous annual report was $11,271,400. The report also discusses the possibilities of the mine, should it be found on further development that the main ore-bodies continue throughout to a depth of 550 ft., that being the depth of the lowest working. Upon this assumption there would be an addition to the estimated reserves of 476,800 tons, containing $5,897,800 gold. Working costs averaged over the year amounted to $6·97 per ton, but toward its close were reduced to $5·21, and an ultimate reduction to $4·50 per ton by the adoption of more economical methods is anticipated.

The Dome during January treated 13,900 tons of ore producing gold to the value of $111,500, as compared with 13,470 tons yielding gold of the value of $106,904 in December. The shareholders of the Dome Lake have authorized an increase of the capitalization from $750,000 to $1,000,000. Of the new issue 150,000 shares will be offered at 30 c. to raise funds for development, and the remainder will be held in the treasury. The Schumacher, hitherto operated as a private concern, has been incorporated, with an authorized capital of $3,000,000, and stock will be offered to the public. A good deal of development has been done on the 100-ft. level, and the shaft is nearing a depth of 200 ft. The Lally mine, in Turnbull township, which has a large quantity of ore on the dump, and is preparing to instal machinery, has been taken over by the Lally Gold Mines, Ltd., capitalized at $3,000,000. The Porcupine Reserve Mines, Ltd., is being wound up. It had a nominal capital of $2,000,000. Many of the shares were sold at $2\frac{1}{2}$ c., but for a considerable proportion of them payment was never made.

Kirkland Lake. — The Kirkland Lake Proprietary Mines, Ltd., of London, is taking up its options on a number of properties in this district, and last week met the initial payments due on several deals, including the Hunton, Horne, Stevenson, Stellar, and Wishman properties. At the Tough-Oakes mine, the gold content in the porphyry is higher than in the overlying conglomerate. On the 200-ft. level the vein is strong and well-defined, and after entering the porphyry 30 ft. from the shaft improved both in width and richness. The gross value of ore blocked out on three sides is estimated at over $750,000.

Cobalt.—There is a considerable revival of public interest in Cobalt stocks, and the market has been active with a generally upward tendency during the past week or so. It began by a sudden rise in Peterson Lake, due to the discovery of two veins of high-grade ore in following a drift from the old Kerry shaft from the Keewatin into the conglomerate. The stock jumped from 25 c. to 50 c. in one day, and large quantities have since been changing hands. Several of the other cheaper issues, which were regarded as practically dead, are looking up, and are in some demand. Possibly the breaking of the Western real estate boom, which absorbed much money that would otherwise have gone into mining stocks, and the general dulness of the real estate market throughout Canada, may account for the renewal of speculative activity.

While other stocks are for the time being on the up-grade, Nipissing, for long the leader of the market, has experienced a set-back owing to the impression that the present dividend rate of 7½% per quarter cannot be maintained. During the past four years this mine has paid upward of $9,000,000 in dividends, its annual requirements for that purpose being $1,800,000. The grade of the ore mined has latterly been decreasing, and assuming that the present rate of production is maintained, it is calculated that the output will barely meet the dividends. It is not considered likely that the management will draw upon the surplus to make good any shortage, so that unless further discoveries of importance are made, a reduction of the dividend rate appears likely in the near future. The annual statement of the Trethewey for 1913 shows a total production of 619,427 oz. having a gross value of $365,566. The gross revenue was $334,769, operating expenses were $204,072, leaving a net revenue of $130,697. The ore reserves were estimated at 585,970 oz. The surplus carried forward was $146,148. The January statement for La Rose Consolidated shows a production of 140,387 oz. The total income was $83,451, less expenses amounting to $53,135, leaving a net profit of $30,316. The surplus amounted to $1,564,331. At the annual meeting of the Crown Reserve on January 28 President Carson said that the programme for the year was to expose the rock bottom of Kerr Lake, and that the payment of monthly 2% dividends would be continued. The development had been far in excess of any previous year, amounting to 5345 ft. The production amounted to 1,776,678 oz., and the net value of shipments was $1,040,117, the net profits being $528,287. In the six years of its operation the company has had an output of 17,000,000 oz. of silver, and paid dividends and royalty of $6,381,790. Only one-third of the property has so far been explored.

The Canadian Canoe in Winter.

Conservation of Oil Supply.—The Canadian Government, acting on the request of the British Admiralty, has introduced a bill in Parliament giving the government power to control or prohibit the exportation from Canada of crude or partly manufactured petroleum. Premier Borden explained that it was not intended to exercise the power conferred on them for commercial reasons, but that it was regarded as important in connection with the defence of the Empire. He intimated that if private interests suffered in carrying out this policy compensation would be given. New regulations have been issued governing the leasing of petroleum and natural gas rights in the West, fixing the rental at 25 c. per acre for the first year, and 50 c. per acre for subsequent years, leases to be for 21 years renewable for a like period. The maximum area of a location is fixed at 1920 acres, and conditions are imposed as to the value of the machinery to be installed for operating the claims. Some uncertainty is said to prevail as to the validity of the leases held by a number of the companies organized to operate in southern Alberta, as the question has arisen as to whether patents for homesteads previously issued by the government included mineral as well as surface rights.

CAMBORNE

Dolcoath.—The report and accounts for the six months ended December 31 last have proved dismal reading for the shareholders in Cornwall's premier mine. The gross profit earned was £10,131, from which has to be deducted £4966 for depreciation, so that the net profit was only £5165. This is a very narrow margin of profit, less than two shillings per ton, especially when it is remembered that the average price realized for the tin concentrate was nearly £108 per ton. It is clear that some of the shareholders are disquieted at the position of affairs underground. From the speech of the manager, it is evident that the developments in the bottom levels have proved disappointing, small isolated bunches having taken the place of the previous continuous deposits, although there is no apparent change in the granite. It would probably not be money ill spent to employ a geologist to make a thorough investigation. A subsidiary shaft has been sunk below the bottom level for 60 ft., and is to be put down at least a further 240 ft. This should afford the management some valuable data. The western portion of the mine around Wheal Harriett shaft is to be vigorously developed, and in view of the fact that none of the lodes here have been tested below the 400-fm. level, the driving of the 550-fm. level west, which has been started, will be watched with interest. The developments on the South Entral lode at the 210-fm. level have also proved disappointing. This lode is evidently patchy. By a coincidence it was intersected just before the August meeting at one of its best points, for the greater portion of the 19 fathoms driven on its course has not disclosed ore in profitable quantities. However, the developments on this lode, in the opinion of many good judges, are not without promise. The 210 cross-cut is to be extended north to intersect the North Entral lode, and this is another point to be watched. Fortunately the company has adequate funds in hand to prosecute a vigorous development campaign, and as there is ample scope for exploration, there is no need to be despondent.

The statement made by the manager that the electrically-driven pumping plant had proved efficient and economical would have been more acceptable if it had been accompanied by comparative figures; he did, however, say that as compared with the old steam plant, there had been a saving of £2000 per annum, or say 9d. per ton of ore treated, but I rather fancy it could be urged by supporters of the Cornish pumping engine, that a *new* steam plant would have shown a still better result.

South Crofty.—The net profit earned in 1913 was £18,867, which compares with £25,201 for the previous year. The ore treated shows an increase of 3290 tons, but the grade treated was again slightly down. The black tin recovery was 20·45 lb. per ton against 21·28 lb., and the total monetary value of the ore was 28s. 10d. per ton as compared with 31s. 4d. The total cost, including depreciation, figures at about 24s. per ton. The development footage was 4588 ft. or not far short of that of Dolcoath, but the lode-values exposed have been generally low grade, and especially so in the New Cook's section. At Crofty, the main developments have been west of Robinson's shaft, which is now down 25 ft. below the 290-fm. level. This has chiefly been because the ground to the eastern boundary down to the 260-fm. level has been developed, while westward the drifts are in comparatively virgin ground, and will eventually communicate with the New Cook's shaft and thus give natural ventilation. The 205-fm. level west has been driven 1160 ft. and for the portion driven during last year will average 24 lb. tin and wolfram per ton, while the 225-fm. level west, by eliminating the poorer sections, will probably average 22 lb. per ton. The lode in the 290-fm. level shows a distinct improvement. New Cook's shaft is now 960 ft. deep from surface and is within a few feet of the 160-fm. level in the old workings, which are full of water under the 148-fm. level. The permanent winding plant has been fixed in this shaft to the 148-fm. level, and the water in the old workings will be bailed with skips, an air-driven pump being used to raise the water to the 148-fm. level. A new electrically-driven compressor, of 1000 cubic feet per minute air capacity, has been installed on this shaft. It is a pity that an otherwise complete report gives no details of working costs; a progressive management, such as obtains at South Crofty, should not lag behind other mines in this respect.

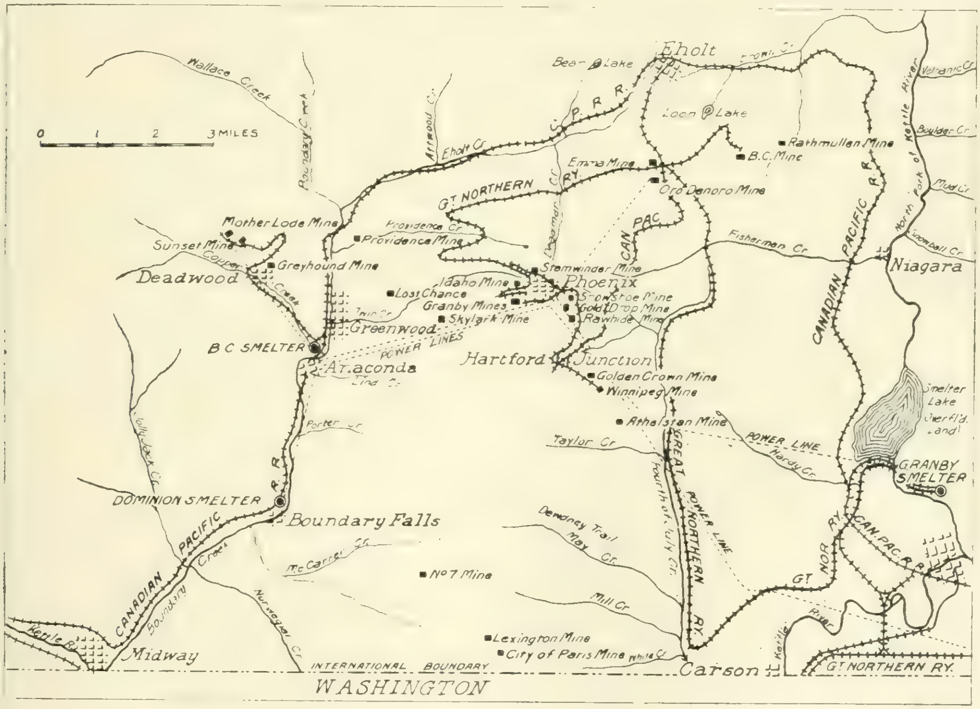
Grenville.—The accounts of this company show a materially decreased profit, owing chiefly to a drop of £29. 9s. 7d. per ton in the average price received for the tin concentrate sold, and a fall of 2 lb. per ton in the recovery.

The profit for the six months ended December 31 last was £5668 against £14,446 for the previous half-year, no depreciation being charged. The receipts figure at 33s. 8·8d. per ton, the expenses at 28s. 6·2d. and the profit at 5s. 6·6d. The tonnage milled was 21,770 against 22,227, and the recovery 34·67 lb. black tin per ton. A start has been made to sink Fortescue's shaft below the 375-fm. level. This level west is in 44 fm. from the shaft, and for the last 20 fm. has averaged 50 lb. black tin per ton. The end east at the same horizon is poor, but a known shoot of ore should shortly be encountered. It is proposed to communicate the western ends at the 355 and 335-fm. levels with Goold's shaft, and the management is of the opinion that this work will develop considerable quantities of ore.

From the speech of one of the directors, it appears that some criticism has been evoked, at last, at the absence of any published figures of working cost. This company gives less information on this score than any of the other large Cornish mines, and it is to be hoped that this will be remedied in future reports. If reforms are on the tapis, I would suggest that the manager should report the widths of the lodes, and also give the stope-values in pounds per ton and not monetary value per fathom.

SAN FRANCISCO.

The British Columbia Copper Co., after an eventful and somewhat precarious existence, is about to disappear into a new corporation, to be known as the Canada Copper Corporation, Ltd. The British Columbia company was launched in 1898 when the copper-bearing deposits occurring along the boundary line between the province of British Columbia and the state of Washington were expected to prove wonderful money-makers, by the mining and smelting of low-grade ores on a large scale. The outcome has been somewhat disappointing. The British Columbia never proved profitable enough to be developed expansively. The Granby, not far distant, has worked on a large scale but without making great profits, and has recently taken over and equipped a property at Anyox which is expected to do better. The holdings of the British Columbia are extensive and were increased by its purchase of the control of the New Dominion Copper Co., of which it owns 64% of the stock. During the past year it has been extending its holdings and has had a number of properties under option and examination. It has a small but well built and excellently operated smelting plant, and the mining methods used in its principal



THE BOUNDARY DISTRICT, BRITISH COLUMBIA.

mine are cheap and efficient. The situation of the company illustrates the American saying, "Root, hog, or die," and the management has been rooting industriously and now has developed 4,000,000 tons of ore carrying 1·87% copper and 25 to 50 c. per ton in gold and silver, but has no cash on hand to enlarge the scale of operations. It is therefore proposed to turn over the British Columbia company, which has issued all of its $3,000,000 capital to the new company, with $5,000,000 capital. This company will then issue $1,000,000 in 10-year 5% convertible bonds. The new company offers the shareholders of the British Columbia company the privilege of exchanging their holdings share for share, providing they subscribe for $1 worth of debentures for each $5 share exchanged. Hayden, Stone & Co. have underwritten $600,000 worth of debentures, with an option for one year on $400,000 more worth of debentures and $200,000 worth of stock. Such is the magic of the name associated with Utah Copper and other profitable enterprises that when this fact was first announced the shares of British Columbia advanced to $4 per share. When the full details of the financing were given out there was a marked revulsion of feeling, and the shares, which are par at $5, declined to $2. The ordinary shareholder naturally fails to see what he gains by exchanging his shares in a $3,000,000 corporation for shares in a $5,000,000 corporation, and at the same time taking on a lot of bonds. In other words, the holder of 100 British Columbia shares is required to buy 20 shares of Canada Copper at par in order to make the exchange. Thus the shareholder for $300 gets 120 shares of Canada Copper that on the present footing of the two companies is worth about $150. Of course, they are expected to be worth much more than that in the future.

Metallurgists were greatly interested in the hearing before the United States Circuit Court of Appeals of the case of Minerals Separation, Ltd., against James Hyde *et al.*, at San Francisco on February 19 and 20. The record of the case in the district court, amounting to three bulky volumes, had been reinforced by the usual printed briefs and arguments. The court hearing was devoted to oral arguments occupying six hours in all and divided equally between the two parties to the controversy. Three judges sat in the case and it was agreed upon all sides that the trial was before a notably competent bench. Of the three, one is a well known expert on patent law, another one before whom many mining cases have been tried, and the third, one who has lived long in mining states and who is well considered as a lawyer and judge. There can therefore be no complaint, however disappointing the decision is sure to be to one or the other party to the suit.

As a whole the arguments were well made and well considered, though one of the attorneys did make the surprising statement that smelters would not receive concentrate containing oil, while an opponent averred that a quarter of a century ago there was not one metallurgist of international reputation. It must be confessed, however, that the legal gentlemen in general seemed to have really studied the technology involved and the hearing as a whole constituted an excellent short course in flotation; for which presumably the hearers must thank Dr. Gregory, Mr. Nutter, Mr. Hyde, and other experts behind the legal screen. The arguments were illustrated by demonstrations of flotation as accomplished under the Elmore, Cattermole, Froment, Kirby, and Minerals Separation patents understood by each side; and A. M. Higgins, the operator who did the actual work when the Minerals Separation discovery was made, repeated that now classic experiment. It would be improper to attempt to forecast the finding of the Court, but a brief statement of the arguments advanced on each side may be given.

Mr. Hyde and his associates, who appealed from the finding of the district court that they were infringing on the Minerals Separation patent, hold that instead they were but using the knowledge of the prior art with skill and metallurgical knowledge. They cited particularly the Everson and Kirby patents. It is conceded by all that the affinity of oil and oily substances for sulphides had been long known, and there seemed no disposition to question the fact that Miss Everson discovered the usefulness of acid in intensifying the selective action of the oil. There is also no controversy over any form of film flotation or bulk oil rafting, to which latter category the Elmore process was referred. In the lower court much was made of the Everson and Froment patents. At the San Francisco hearing the Kirby patent was strongly urged as anticipating the Minerals Separation patent. This was taken out by Edmund Kirby shortly before the patent in litigation and was based upon work done by him in British Columbia. The essential novel features were that he proposed to use a light oil, that it should be heated, and that at one stage of the process he bubbled air into the mixture. He also specified violent agitation, and it is contended that this could not have been done without producing a froth, which is admitted to be the peculiar and distinctive characteristic of Minerals Separation flotation. It was also brought out, which was a fact discovered by the defendants' experts in the course of the trial, that an excess of oil, in certain cases at least, does not prevent formation of a froth. They therefore held that in the work at the Butte & Superior mill at Butte the metallurgists were merely using the common knowledge of the prior art with due effort to decrease consumption of oil. It was urged that in decreasing the amount of oil Minerals Separation had not produced a new result but had merely striven for economic efficiency and hence could not claim invention.

In reply Minerals Separation presented an excellent and instructive history of the art. It was urged that the froth of 'armoured bubbles' first produced by Mr. Higgins was a wholly new thing and not to be confused with the incomplete formation of bubbles in an excess mass of oil that was the best that could result from the Kirby process. The Froment process was illustrated but held to be worthless, and the various bulk-oil processes were held to be uneconomical and proved by experience to be worthless in actual practice. As to the possible formation of a froth with larger quantities of oil, it was urged that the so-called froth was not a true 'flotation froth'; that it was a mass of oil in which bubbles were entrained and intrapped rather than a mass of air bubbles of which the walls were formed by sulphide particles and in which the oil was so small an element as not to be determined except by analysis. Strong emphasis was also placed upon the fact that prior art had not in fact resulted in the treatment of ore in quantity, while the Minerals Separation process went at once into actual use and had resulted in the establishment of a new industry. Incidentally it was brought out that the earlier processes made no attempt to treat slime.

Interest in the case is widespread and keen since it relates to a basic process patent, and if Minerals Separation wins, it is expected that royalties will be collected upon many tons of ore in many districts. If not, the whole process will be open to any operator practically without charge. The patents still have about ten years to run, and enough has been done to demonstrate that flotation is widely applicable to copper and zinc ores now being wasted in the United States. In more than one mill tests are being made, occasionally behind locked doors, and a number of new plants will undoubtedly be built, however the suit may terminate. While under the United States laws further litigation is possible, a decision of a Circuit Court of Appeals in such a case is usually accepted as final.

California petroleum fields are by no means completely developed and even in territory that has been considered disappointing good results are obtained occasionally. The Lost Hills district, for example, is now attracting renewed attention, because of wells drilled on ground belonging to the Standard and General Petroleum companies. The latter company obtained, the last week in January, a new well, No. 6, which at a depth of 1677 ft. spouted over the derrick. It settled down to a production of 700 bbl. per day. This and other wells brought in within the last few months has started drilling in virgin territory in the vicinity. In the Sunset district, exploration of lower sands under Maricopa flat is also resulting favourably. The Spreckels No. 1, on Section 32, came in at 2611 ft., with a yield of about 1000 bbl. per hour. The production has settled down to 9000 bbl. per day of 26° oil which brings 60c. per barrel.

NEW YORK.

Copper.—One interesting feature of the management of the big copper producers is the large stocks of unsold metal that they seem to find it necessary to have in hand. The Copper Producers' Association reported for January 1, 1914, that the refineries had on hand 91,000,000 lb. refined copper. The Utah, Ray, Chino, and Nevada Consolidated companies alone reported a stock of copper 'on hand and in transit' of 109,000,000 lb. The stock in the hands of the producing companies therefore forms a sort of reservoir serving to equalize the fluctuation of mine output and trade consumption. It is doubtless true that the stocks in the yards of consumers are much larger than is commonly realized, which explains why they are able to stay out of the market for longer periods than producers sometimes expect. The Nichols Copper Co., which has the largest refinery in the world, has recently increased its capital by the issue of $1,000,000 worth of 8% cumulative preferred stock and presumably will increase its capacity as well. The company is under the direction of J. B. F. Herreshoff, well known as the inventor of an excellent roasting furnace, and brother of the even better known yacht designer.

Mining Law.—One of the factors militating against the investment of foreign capital in American mining ventures is the unsatisfactory code of law. A hodge-podge of miners' customs, devised without reference to the actual facts of ore occurrence, it has been stretched and patched to cover the bare facts. The iniquitous law of the apex makes it possible for the discoverer and exploiter of a mine to have it taken from him by some later adventurer who happens to drive his stakes in such a place as to give him the title to the whole deposit, as in the Drumlummon mine, where a British company defended its title to the mine for twenty years and finally gave up the property rather than pay the damages awarded against it. As a result not a few engineers, in the case of two properties of apparently equal merit, one in Mexico and the other in the United States, would recommend their clients to purchase the one in Mexico, since revolutions can only damage the property, whereas in the United States it may be lost altogether. Dissatisfaction with the law has been growing for many years, and has at last reached the stage where some effective action is about to be taken. Reed Smoot has introduced into the Senate a bill creating a concession to draft a new code of mining laws. The bill in its original form provided for a commission of lawyers to draft the code, but after having endured nearly fifty years of laws devised in ignorance of geologic facts it is inconceivable that mining men will submit to a new code devised by lawyers who can scarcely be expected to frame laws to eliminate litigation and thereby remove their means of livelihood. The oil and gas laws are in even more critical need of revision, and it is quite likely that well devised legislation will be enacted during this session of Congress, since that body made such short work of the tariff and banking legislation.

MELBOURNE.

Broken Hill.—The news of the reversal of form in the money-market of London and the Continent in January was received on this side of the world with incredulity, but the stiffening of the price of all shares of international importance convinced the exchanges that financial ease had at last come. Perhaps no company has welcomed the change more than the Broken Hill Proprietary. With the big obligations involved in its iron and steel enterprise it had to depend for capital on the proceeds of the last issue of shares, *plus* any surplus profits. The hostilities in Mexico, with the consequent hardening in the price of lead, has enabled the board to declare the usual quarterly dividend, but it was seen that sooner or later the directors would have to face the question of getting more cash. A belief has existed that Continental financiers were prepared to let the board have money, but on what terms no one has been enabled to learn. Perhaps they may contemplate the fettering of the output of iron and steel from the new works at Newcastle. As the board joined the lead convention it would not be a far step for it to glide into the iron and steel ring, although any move of the kind would in all probability set the socialist element in Australian politics by the ears. The adherence to the political plank—the nationalization of the iron industry—by the labour party, is intense, and with labour in power in New South Wales any alliance of the kind by the Proprietary company might lead to a demand that the plank shall be used effectively in party politics. However, it is asserted that the company has secured orders for 150,000 tons of material from the new works, so that a good start will be made with the enterprise. It may be added that other rumours are current respecting the way in which the company intends to finance. One is by another issue of shares, though the advance in the price of scrip seems to discount this suggestion; another, that it has taken action to place its lead output under control. Anyway, the market tells that some fresh move is on, and of such a nature as to mean strengthening the finances of the company on good terms to itself.

Coal.—Victoria has been doing its best to build up a coal output by state subsidies, and latterly by nationalizing the industry. Really, until the Powlett Basin seam was discovered in Gippsland there was nothing much to talk about. Since then, a little advance has been made, due entirely to the development of the Powlett coal seam by the State.

The following table illustrates how the yield has grown in the last five years, and the part played by the State mine:

Year	State Mine	Jumbunn	Outtrim Howitt	Austral
1909	2,946	65,945	44,156	10,630
1910	201,053	61,954	46,831	36,051
1911	506,059	57,397	28,359	34,606
1912	455,659	53,305	24,326	31,506
1913	486,238	38,795	22,460	33,461

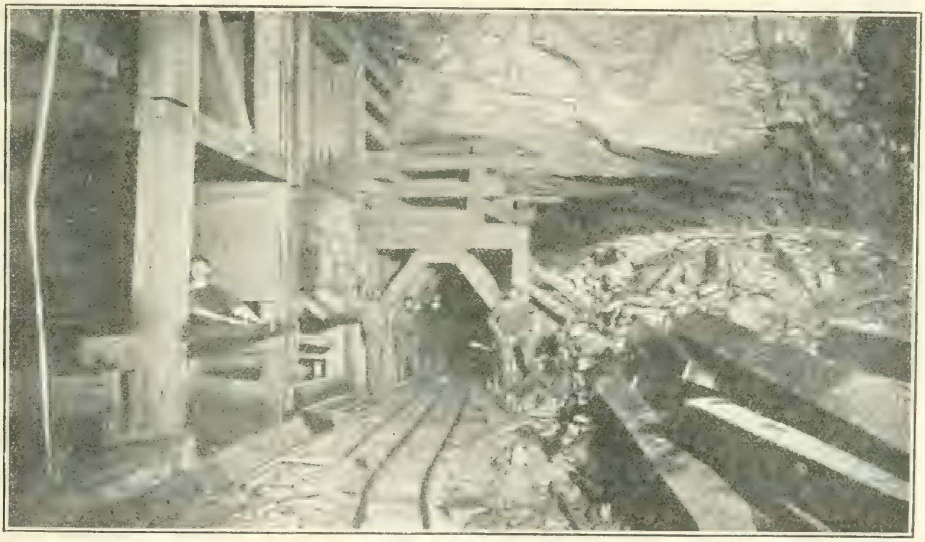
The total output for the years mentioned, and the value, were:

Year	Output Tons	Value £
1909	128,173	76,870
1910	369,059	188,977
1911	653,864	298,829
1912	589,143	258,455
1913	593,912	274,371

These figures are puny compared with the output of New South Wales, which goes a long way toward seven figures. There no discovery of coal has been made of late years at all comparable with that at Bowen, in Queensland, where some magnificent seams have been bored through of late. The result is that Mr. Dunstan, the Government Geologist, estimates the probable coal resources of this great northern province of the Commonwealth at 55,000,000,000 tons. As there certainly are large coal-bearing areas in Queensland still unknown, it can be seen that Eastern Australia is not likely to run short of fuel for a generation or two. By that time the folly of the State trying to conserve to itself, as in Victoria, the whole of its coal resources may be demonstrated, and enterprise will then be given the chance to turn this concealed wealth to proper account.

Gold.—The 'deep lead' industry in Australia is waning rapidly. News is out that the Great Southern mine in Victoria is now to close-down. This will mean bringing mining in the Rutherglen field pretty well to a close. The district was rich in the early days, but as the ancient gold-bearing channels have been followed down the 'wash' has become wider, and the gold less concentrated. There has at the same time been an increase in pumping and mining costs, with a decline of profit. Then, too, labour has demanded, and been awarded by the wages-boards, a higher payment. Result: a flitting of capital from the old mines. The Great Southern is typical of the deep lead industry. The paid-up capital, mostly contributed in monthly calls of 3d. per share, was over £99,000; the gold won was roughly £520,000, and the dividends only about £60,000. Such a record as that tells of intermittent yields and general disappointment. So it is as well that the end has come.

One of the most interesting problems in mining is the depth at which lodes become unprofitable. In the Ballarat district of Victoria very few mines have been profitable at over 1500 ft. In the mountains round Bright, where rich surface deposits existed, it is an axiom that the gold fails to live below the level of the creeks of today. At Bendigo the result obtained at a greater depth than 2500 ft. on the main saddle-formations has been so disappointing that now the majority of the companies have transferred their exploratory work nearer to the surface to test side 'lines of reef.' In the Maldon district, only about two mines have been at all productive at below 2000 ft., and in Gippsland only the Long Tunnel paid at much below that vertical depth. Now at Great Arnaud the Lord Nelson mine is about to close-down, the grade of the ore having declined to about 5 dwt. at a depth of somewhat under 3000 ft. In the Daylesford district hardly a mine has paid below 1000 ft. So it can be deduced, first of all, that even in the best parts of Victoria the danger zone of quartz mining is at about 2000 ft., while in others it begins at a somewhat less depth than 1000 feet.



UNDERGROUND IN THE BROKEN HILL PROPRIETARY.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

Feb. 1914	Jan. 1914	Feb. 1913
£65. 8s. 5d.	£64. 8s. 0d.	£65. 12s. 4d.

The February market has been in somewhat lethargic mood. Not only has the volume of business on the Exchange been small, but the variation in price has been narrow. On the other hand, shipments of American electrolytic copper to Europe continue unchecked on the huge scale lately established. This is the more remarkable in face of the heavy fall in American home consumption since October. Little that is coming forward is finding its way into public store; the significance of this needs no comment. In spite of so much to encourage them, American consumers are in worse case than those on this side. Although reports regularly come to hand of slackening trade in Germany, it has not proceeded so far as to check consumption.

The effect of the new selling arrangements made by the Amalgamated Copper Co. in Europe has been to increase the competition for orders with the Guggenheim interests. While consumers may congratulate themselves on the change, the benefit to producers is debatable. Electrolytic during the month has slowly declined from 14·87½ c. to 14·25 c., and in England from £68. 10s. to £66. 10s. Though demand has been slack since the year opened, a fresh buying movement on a large scale is probably not far off. Some important schemes are reported to be maturing that will require plentiful supplies.

TIN.

Average prices of cash standard tin:

Feb. 1914	Jan. 1914	Feb. 1913
£181. 12s. 0d.	£172. 0s. 11d.	£220. 6s. 3d.

The rise that set in during January made further progress during last month, until forward metal was sold at £189. This proved the turning point, and from that level prices gradually receded until the middle of February, when some heavy realizing orders from different sources caused the market to break sharply. Prices never recovered, and the month closed with prices at the lowest level, namely, £173. 5s. cash and £175 5s. three months. It has again become difficult to read the further development of prices. The operations of the bull syndicates have become obscure. They have probably liquidated; and in any case have not at present the assistance of a good American market. Although sentiment may be guided so far as outsiders are concerned by statistical showings, this actually counts for little where manipulation upsets all calculations. Operators lose faith in their own judgment, and their only safety lies in following the steps of the market bellwethers. It seems reasonable to expect a recovery, but that expectation must be more a matter of faith than of deduction.

LEAD.

Average prices of soft foreign lead:

Feb. 1914	Jan. 1914	Feb. 1913
£19. 2s. 8d.	£18. 19s. 9d.	£16. 8s. 5d.

This has been the best market on the Metal Exchange, prices showing steadiness and strength in contrast to other sections. For one thing, speculators have not been so ready as in past months to indulge in heavy bear sales, their ardour having been damped by the difficulty in finding metal to complete their contracts. For another, the scarcity of supplies is becoming acute, while demand ought now to be reviving. Russia has already begun to purchase for open-water delivery. The recrudescence of labour unrest in New South Wales is likely to affect Broken Hill supplies.

SPELTER.

Average prices of good ordinary brands:

Feb. 1914	Jan. 1914	Feb. 1913
£21. 7s. 6d.	£21. 9s. 9d.	£25. 4s. 3d.

This market showed a hardening tendency with not a great deal of business passing. Galvanizers are reported rather busy, but are showing themselves lukewarm as regards fresh purchases. At the last meeting of the convention it was decided not to alter prices.

OTHER METALS AND MINERALS.

Prices quoted on March 10:

SILVER.—26¾d. per oz., standard.

PLATINUM.—185s. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£81 to £83 per ton.

NICKEL.—£170 per ton.

ANTIMONY.—£29 to £30 per ton.

ARSENIC, WHITE.—£13. 10s. per ton.

QUICKSILVER.—£7. 10s. per flask.

MANGANESE ORE.—8½d. to 10d. per unit.

IRON ORE. — Cumberland hematite 19s. per ton at mine. Spanish 18s. delivered.

PIG IRON.—Cleveland 51s. per ton. Hematite 61s. per ton.

WOLFRAM ORE.—33s. per unit (1%).

DISCUSSION

Godfrey Doveton.

The Editor:

Sir—I crave a few lines of space in your columns to testify to the deep sorrow which all the friends of Godfrey Daniel Doveton must feel at his untimely death.

News has just reached me that Doveton, while at the Cinco Minas mill in Jalisco, Mexico, was caught in a conveyor-belt, and died at Guadalajara as a result of his injuries.

During a four years' partnership with him in Denver and in previous work under his guidance at the Camp Bird cyanide plant, in Colorado, I learned to love this man for his character and to acquire a profound respect for his thorough knowledge and unerring technical judgment. My own experience was that of all others who came in contact with him. Amid all the charlatanry, sharp dealing, and temptation with which the busy metallurgist must ever come in contact, and Doveton was certainly one of the busiest, he remained solid in his unblemished integrity, firm as the concrete foundations of one of his mills. So high was his character that money-lust and attempts at fraud in others merely amused him. So intense was his love of, and so tremendous his capacity for, hard work that he was frequently known to stay 36 hours at a time on a problem with no sleep and little to eat. Of him might Kipling say, indeed: here was a man to whom the idea of wealth as mere wealth would never appeal, and whom the methods of amassing wealth did not interest. Whenever and wherever you (the common money-getter) meet such a man, as soon as it comes to a direct issue between you, his little finger will be thicker than your loins. You will find that you have no weapon in your armoury with which you can attack him, no argument with which you can appeal to him.

As a gentleman and as an engineer he represented a high type of the English-speaking man. He lived a life of efficient and conscientious achievement and died in the strife of circumstance as truly a hero as the soldier killed in his country's service on the field of battle.

C. W. PURINGTON.

London, February 15.

[We are glad to give space to this tribute of friendship. Godfrey Doveton was known to us also, both in New Zealand and Colorado. We join in regretting the untimely death of a big-hearted, capable, and honourable man.—EDITOR.]

Ore.

The Editor:

Sir—Through your Magazine you are performing a most valuable service by stimulating a discussion on the definition of one of our basic terms, and if there is no other visible result than that the rank and file of the profession are again forcibly reminded of the desirability of precision in the use of technical language, a considerable step forward will have been accomplished.

Professor Kemp aptly remarks* that "use is the law of language" and granting that premise, it is apparent to any impartial observer that the majority of persons who use the term 'ore,' and I include you, Sir, among the number, commonly give it a wider application, a broader meaning than is implied by your own very concise definition,† wherein it is restricted by the standard of profit.

A number of your contributors have shown an inclination to favour this restriction without giving any clear reason for so doing. If I may be permitted to suggest it, there is an implied compliment to you in so far as these gentlemen approve of precision of language.

In the endeavour to standardize our technical language I think most people will agree that it is desirable to maintain simplicity of form without sacrificing accuracy, and that if we are to discard one term to substitute another equally vague no gain has been made.

One correspondent has quoted a number of definitions taken from various authorities, and

*The Mining Magazine, February 1914.

†"Ore is metal-bearing rock that, at a given time and place, can be exploited at a profit."

while I in no way wish to cast any reflection on my friend Mr. Trewartha-James, I think that all of us are only too prone to regard a dictionary as a beneficent and infallible providence, whereas, as a matter of fact, the individual responsible for, say the mining terms in any one of the standard dictionaries, is probably not as well qualified to lay down the law as are you, who, in your capacity as editor, spend your life in contact with the active side of mining to a degree shared by few.

'Ore' is a word that is perhaps more used than any other mining term, and it seems to me that we want to define it from the standpoint of the miner, for after all, metallurgy and geology are subsidiary to mining, and if there were no mines there would be very few geologists and no metallurgists.

Mining conveys the idea of profitably exploiting rock containing mineral or minerals that can be converted to economic use. The material mined, we, by common accord, designate as 'ore,' the idea of profit still persisting. There is no gainsaying that basic fact, namely that we mine with a view to making a profit. However, not all mining operations are carried on at a profit; that inexorable financial record, the balance-sheet, shows that the vast majority of companies have gone down to their inevitable exhaustion without repaying the capital invested. If profit means the difference between the actual cash expended and the actual cash received, then all such companies have been exploiting not 'ore' but 'waste.' Further, we should have no right to designate as ore the material mined until the entire capitalization of the company has been repaid in dividends to the shareholders.

I admit that this argument involves the question of mine finance and therefore complicates the situation somewhat. Let us examine the position from a different viewpoint and reduce the stipulation of profit merely to imply the surplus after all costs of operation including renewals, repairs, head-office expenses, etc., are deducted from the actual yield, but excluding amortization of the cost of the mine.

If use is the law of language, I submit that the word 'ore' as commonly used is a generic term—of which we have a number in mining and metallurgy, such for instance as 'concentrate,' and to make clear the meaning intended it is necessary to add a qualifying adjective.

A Broken Hill mine may produce lead concentrate and zinc concentrate. Such expression conveys no idea of quality, although without doubt the main purpose of making a concentrate is profit. Yet the metal markets or some other economic condition may prevent the profitable disposal of either one, even after it is made, while the other may be making dividends for the shareholders. Likewise the word 'blende' conveys no exact idea of the percentage of zinc present, for the blende may be impure. Numerous other similar words suggest themselves. Outside of technical subjects, there are a host of class words, such as 'horse.' I say to you "Yesterday I saw a horse." You have no idea of the kind of horse. You may picture to yourself a Clydesdale, while I meant an American broncho. If I tell you it was an American broncho, you gather a meagre impression, unless you are familiar with that type of horse, and even then you know nothing of his colour, size, speed, or endurance. So it is with ore, as it is at present used. It is without question a vague term that requires at least a qualifying adjective to convey an exact meaning.

It is no hardship to use an adjective, such as, for example, 'profitable,' but it may be a hardship to restrict the meaning in such a way that a new word or words will have to be found for all that portion of what we now commonly describe as 'orebody,' which is below grade.

I, for one, shall gladly welcome a definition that will standardize the use of the word, that will minimize misconception, and that will be clearly intelligible to that public on whom we are dependent for our livelihood and whom it is our desire to protect from fraud. However, I see a number of difficulties in the discarding of so convenient and simple a word as 'ore,' as now used, and if I may trespass on your space will set some of these out in the form of particular illustrations taken from every-day practice.

1. An engineer visits a mine at a distance from his base where he is unable to ascertain and determine all the economic factors. He finds a mineral deposit that given certain conditions will yield to profitable exploitation. He submits the tentative basis, realizing that commercial success depends on the fulfilment of these hypothetical factors.

How is he in writing his report, without resorting to cumbersome expressions, to describe the mineral mass? Before the question of profit appears in his report, detailed descriptions must appear of the geology, the mineral deposit itself, the underground workings, metallurgical treatment, etc. All through these descriptions the word 'ore' would commonly appear; if he speaks of 'mineral' he may be wrong for it may be an aggregate of minerals; 'lode-stuff' is equally undesirable as being too nondescript. The description of it by its constituents is out of the question; he could not say the mispickel-pyrite-chalcopyrite-blende-galena material. What would you do in such a case?

2. Given a low-grade copper proposition unprofitable with £60 copper. At £61 it becomes 'ore.' How shall we describe it in our reports? In remote places the engineer may be writing of ore and before his letter is in the post, he may find news of adverse metal markets and what he has just written is wrong. What shall we substitute for 'ore' here, Mr. Editor? Do we not use a perfectly definite expression in using the word 'ore' and in its proper place explain the economic conditions under which it can be exploited at a profit?

The word becomes definite the moment we describe the ore of the mine. The ore consists of a mixture of bornite, chalcopyrite, and small amounts of zinc blende, in a quartz gangue. That defines the word in the particular instance, and there can be no misconception about it. The question of profit is a variable factor depending on such things as management, acts of God, strikes, transport, drought, labour supply, which last may be dependent on the prosperity or otherwise of the agricultural or pastoral communities. The lode-stuff does not change.

3. At the Baudwin mine in Burma, there is a lode 900 ft. long averaging 75 ft. wide, and assaying an average of 25% lead, 25% zinc, and 25 oz. silver per ton. At the Mount Read mine in Tasmania there is a large deposit of mixed sulphides of lead, zinc, and copper, with minor precious-metal contents, and others could be mentioned. In neither case has the treatment problem been solved, but it soon may be. How are these to be described without reverting to double-decker words?

4. The North Lyell mine with large bodies of 10% silicious copper and no basic flux available, was amalgamated with the Mt. Lyell with a surfeit of low-grade basic material—millions of tons, in fact, and no acid flux. Apart neither could operate at a profit. Which today is the 'ore' and which the 'flux,' and how would the stuff have been described?

5. The XYZ mine is yielding handsome profits from a given grade of ore; during the development a body of water is encountered that entails such heavy pumping charges that the profit is converted into a loss. Later, cheaper power being available, profit again ensues. What is to be done with the word 'ore' in such a case?

You, Sir, have great facility of expression, you are continually meeting people from whom you learn, good books are yours by stretching out your hand, but the average engineer must content himself with fewer words and less facile speech and withal make himself understood.

Give us a suitable word to define all that portion of the mineral deposit that is below grade and that is physically so different from ordinary waste as to need a separate term, and I am sure the great majority of your readers will give you their earnest support. If we are to add another word to our vocabulary to give a different meaning to a familiar expression when the same purpose can be served by an adjective, I fear the present use of the word will continue.

C. S. HERZIG.

London, February 20.

The Editor:

Sir—In response to your request that I should send you a letter contributing to the discussion on this subject, I must confess to being unable to think of any definition of the term 'ore,' that would, to my mind, be entirely free from criticism.

You have suggested that metalliferous material which cannot be exploited profitably ought not to be termed 'ore.' If this were adopted it would be necessary to state in many cases how far exploitation was being carried by the miner. One miner may have facilities for beneficiating his ore, and making his exploitation of it profitable, while another miner may not have such facilities for treating similar material. If we are to give ore a definition that will make the term applicable only to metalliferous material which can be mined and realized at an ultimate profit to the miner, we are left with no term to describe similar material which cannot be mined at a profit, owing to a lower percentage of its metal content, to its chemical composition, or other causes. We cannot call it 'waste' in all cases, for there are plenty of instances in the history of mining of ore being mined at a loss to the miner and subsequently treated profitably by a custom reduction works. This would point to the necessity of stating what is the limit of metal content required to make the material profitable in each case, and whether it is in place or for sale in bulk.

Surely the more simple and logical course would be to let such comprehensive definitions of the term 'ore' as Mr. McCarthy or Mr. Thomae have suggested stand as they are, and prefix the adjectives 'profitable' or 'unprofitable,' as each particular case may demand.

G. S. DUNCAN.

London, January 6.

The Editor:

Sir—In your November issue I note a letter from Mr. E. T. McCarthy with reference to 'ore,' its definition, and what the term should suitably include. In your comment on the said letter you invite correspondence on the subject.

Some two weeks ago I noted a short article in the *Mining World* with reference to the same word and its definition. A definition by a certain gentleman was therein quoted and an invitation given for proposed definitions by others. I accordingly responded to the editor of that paper proposing a definition and dealing at some length with the matter, as well as with the opinion, also quoted in the same article and from the same gentleman, with regard to the use of the terms 'payable ore' and 'unpayable ore,' which the said gentleman condemned on the grounds that anything "unpayable" is not 'ore' at all.

I will not repeat what I said in that letter, but I take advantage of your own invitation to submit my proposed definition. It is as follows: Ore is any natural aggregation of minerals from which metal has been, is intended to be, or is (or might reasonably be) under consideration to be extracted for purposes of profit.

I do not agree with Mr. McCarthy's views as to what the term 'ore' can suitably be applied. In my opinion the term should be restricted to mineral aggregations in which the objective of work, whether being effected or contemplated, is a metal. In the case of substances such as coal, baryta, limestone, etc., there appears to me to be no reason for the use of such a term. The terms 'coal' or 'baryta' explain themselves in one word. This is not the case with the natural materials which are mined for the purpose of obtaining the metals. A number of words would be necessary to describe such and these descriptions are avoided by using the general term 'ore.'

I do not agree with Mr. McCarthy that it is desirable to apply the term to all products from the earth provided such by treatment are or can be made into useful material, which I think briefly summarizes Mr. McCarthy's definition. To my mind the use of the term in that way would be less convenient than is the case with the definition I submit. This point is one merely of individual opinion and does not lend itself to argument. Certainly I have never understood that the term is generally used according to Mr. McCarthy's definition, whereas I think that my suggested definition does cover practically the meaning of the term as in my experience it is generally used. I can see no reason why the application of the term should be widened, as in his definition.

An objection to the definition I propose may I think be made in connection with the working of such a substance as asbestos, which occurs mixed with a quantity of other mineral matter and must be treated to be separated from same. I can quite believe that the use of the term 'ore' would be useful in working an asbestos mine. Whether it is customary to do so, I do not know. While, however, allowing that there may be some such exceptions to the application of the definition, I think that it meets the case for practical purposes.

It certainly appears that if such divergent views are held as to the application of this much used term it is high time that a definition be agreed upon by mining circles, and I trust that the subject will be so taken up by yourself and others that such a definition can be established.

I agree with Mr. McCarthy that it is impossible to reserve the term 'ore' to profitable material. If a material once becomes the objective of work or of consideration of work (present or future) it should rightly and suitably be termed 'ore.' Besides the one quoted by Mr. McCarthy, a score of instances could readily be quoted where a material might never prove profitable and yet where such material is undoubtedly rightly called 'ore.' After all, the fact of certain material being profitable is only definitely proved after its treatment and the securing of its products.

H. R. SLEEMAN.

Whim Creek, W.A., January 7.

The Editor:

Sir—You are to be congratulated on your attempt to define the meaning of the word 'ore.' But to all interested it must be a disappointment when we have what is tantamount to a confession from the leading mining engineers and geologists of the present day that the attempt is a failure. The only logical reasoning we can adduce from this is that fundamentally our principle of application must be wrong; that we are trying to get a square peg into a round hole. If we have any doubt of this let us examine the fact that however long we study we are unable to differentiate between 'ore' and 'waste.' This is well shown in your last issue by Mr. Read in a supposed conversation between the resident manager and a visiting geologist. However, much as we regret the fact, the word 'ore' under present usage depends entirely for its meaning upon whether it is profitable or unprofitable. This depends in turn upon bad management, lack of suitable labour, locality, and a hundred other transient factors well known to engineers, which go to form an imaginary line between 'ore' and 'waste.' What is 'ore' in one mine may in an adjacent one be 'waste,' simply through bad management, although having identically the same chemical composition. Hence, if we are to make a definition that is to define, we must make it on a chemical basis. Coal is understood to be coal, whether profitable or unprofitable, but this would not be the case if we were to apply the reasoning generally applied to 'ores.' Again, when considering a new definition, we must not outrage well established usage in framing a purely scientific term. Mining is a basic industry, and as such, depends upon the man in the street for financial support; hence we must use terms he can understand, and use intelligently. Our coinage system is obsolete, but to change it would cause an upheaval that we do not care to face. Therefore, to name coal or limestone as 'ore' would be farcical, because to the public they would still be 'coal' and 'limestone.' To my mind the greatest need of a true definition of the word lies in its application to economic geology. In many cases it is difficult to define a writer's intentions when describing ore-bearing and mineralizing solutions. One is inclined to think the writer means as mineralizing solutions the solutions that have carried the gangue minerals; and as 'ore-bearing' solutions, the solutions that have carried the metals. In secondary enrichment, 'metal-bearing' solutions are often nearer the mark than 'ore-bearing' solutions.

To sum up, I have attempted to show that the present usage of the term 'ore' is grotesque and unscientific, that to make a new definition it must be such that the public can understand it. A definition must be world-wide. Hence it is for corporate bodies of mining engineers of this country and America, at least, to say what the definition shall be. A working definition might be found as follows: "An ore is a metallic combination or aggregate mined or quarried from the earth." As the chemical definition of metals is not precise, the metals to be included should be tabulated by corporate bodies. The above definition was placed upon it by several shareholders when asked to define 'ore.' They were surprised to learn that the term was supposed to include profit. This is the definition placed upon it when the words 'profitable' or 'unprofitable' are used, as these words are superfluous under present usage. In the word 'concentrate' we have again the same idea. 'Concentrate' does not convey to us the impression that the gangue minerals have been concentrated, but that the metallic minerals have been concentrated. As an alternative, we might use the mineralogical name of the mineral, and say that copper was worked in the form of pyrite, iron in the form of hematite, or whatever combination the metal took. But whatever term we use, the idea of profit must be rigidly eliminated if we are to have a term that is definite.

WILLIAM MCDONALD.

Moor Row, Cumberland, February 27.

Rio Tinto.

The Editor:

Sir—It will no doubt be gratifying to the English staff at the Rio Tinto mines to find that the cudgels have been taken up on their behalf by the correspondents in your issue of January last. The impeachment of the English staff by your Huelva correspondent in previous issues was as unjustifiable in the whole as it was ridiculous to infer that the recent labour trouble and strikes were partly due to the alleged lack of consideration and courtesy to the Spanish employees and workmen. As far back as 1888, when I was a member of the staff, and when the English and Spanish employees were alike loyal to the company, a general strike was engineered by political agitators who were also at the bottom of the recent trouble.

Besides this, and the present attitude of labour towards capital, it is to be remembered that the Rio Tinto company is regarded in Spain as a rich and powerful foreign corporation, exploiting the mineral wealth and labour of the country to its own advantage, and that it is subject to an undercurrent of hostile feeling, more particularly on the part of the ignorant classes tainted with socialistic and anarchistic ideas. This is an important factor, not only in Spain, but in other countries, as recent events show.

Three years ago while I was visiting a mining centre in Mexico, the socialist agitator in the camp was then preaching, among other tenets, the extermination of the foreigner; a strike took place in consequence, attended by temporary anarchy and considerable loss of life.

So long as professional agitators of this stamp are allowed to poison the atmosphere, there will be periodical eruptions in the labour world, and though an administration may be unimpeachable, it avails nothing when such occur. A. G. WHITE.

London, February 9.

Engineer's Equipment.

The Editor:

Sir—In the December issue of *The Mining Magazine*, in the valuable editorial entitled 'Engineer's Equipment' appearing on page 410, after commenting on the good advice given by Mr. James Douglas, you say: "It is a curious fact that one of the accomplishments most useful to a young engineer, namely, to make a clear report, is not taught in schools of mines."

While this may be true of some schools, it may be of interest to know that the criticism does not apply to the Colorado School of Mines. In this school a course of lectures entitled 'Mine Examinations and Reports' is given to the senior class. This instruction includes the fundamental principles involved in the examination and valuation of various kinds of mining properties. The student is taught how to secure accurate and reliable information and how to systematically arrange and tabulate data obtained in the field. He is instructed in the art of compiling technical information so that it may be presented in clear and concise form to a higher authority, or to a client who may be a layman so far as the technology of mining is concerned but who may know exactly what information he needs for consideration from the standpoint of a good business man.

Another course of lectures given to the senior class of the Colorado School of Mines is called 'Mine Management.' The general nature of this course may be inferred from its title. It includes, however, careful instruction in the preparation of monthly, annual, and other periodical reports of mining operations, to higher officers, boards of directors, and stockholders. HARRY J. WOLF.

Golden, Colorado, January 3.

Kirkland Lake Flotations.

The Editor:

Sir—No one appreciates fair criticism of everything pertaining to mining more than I, but in your article this month on Kirkland Lake Flotations I feel that you have unintentionally allowed your expressed dislike of certain promotion methods, which have rightly or wrongly been employed, to colour your judgment when dealing with the ability and integrity of an engineer and his report.

It is quite consistent with your meritorious campaign against the loose and improper use of technical words to cavil at 'nuggets' being used in my report to describe the coarse pieces of gold found in the Kirkland Lake veins, but what word can better express the pieces of gold taken out of the mortar-box in lumps, especially when they are always so designated in local parlance? To my mind, at least, "lumps of gold" sounds singularly untechnical. Similarly, "length of strike" is, no doubt, not wholly defensible, although it is probably perfectly intelligible and is certainly in common use in some mining countries, especially in South Africa, and it is not altogether unknown even "out West." That 'pitch' is better than "dip-strike" I agree, and indeed I have nothing to say beyond the above explanations to your remarks on those points.

On the question of tellurides, I thought the report and annexures made it clear that nothing was claimed in the way of value for the tellurides, which, as a matter of fact, occur mainly as base-metal minerals, the amount of gold and silver tellurides being practically negligible. You say "It is probable that molybdenite has been mistaken for tellurides," whereas the opposite is actually nearer the truth, as investigations here go to prove that the infinitely small coating of mineral frequently found on the slickensided surfaces of the ore and assumed by many to be molybdenite is really a telluride, though quantitatively of little or no importance.

You complain that I have assumed the presence of ore in the shaft without having been able to see or sample it myself; but surely the unfairness of the inference will be admitted when you bear in mind that the ore is to be seen in the shaft at both the 100 and 200-ft. stations, and that I had the assistance of an assay-plan prepared a month or two prior to my examination by Messrs. Frank Loring and C. H. Henrotin, whose *bona fides* will not be questioned.

With reference to the reserves, I take the strongest exception to your remark that my "estimate evidently did not please the 'management'—presumably the vendors—so he endorses the management estimate of over £400,000." In writing thus you descended from the lofty pedestal of respectable journalism to which the Magazine has attained, to accuse an independent engineer of colouring his statements in order to suit a promotion in which he has absolutely no interest whatever. I submit that it is a charge as unwarrantable and damaging as it is unworthy of you.

My report deliberately set out to correct a number of wild statements that had gained currency regarding the new mining district, and I had no hesitation in presenting my own estimate of reserves beyond which I was not prepared to go at the moment. But in my opinion one is acting in such circumstances in a judicial capacity; one has to weigh the *pros* and *cons*; and I think it would be wrong if one failed to present all the facts upon which other engineers may come to different conclusions; hence my presentation of the management's figures, to which you object.

That the inclusion or otherwise of the cross-cut in figuring the value of ore reserves was considered a debatable point must be evident from the fact that I clearly stated (not as you have done in quoting portions only of the sentence) the assay-values both with and without the cross-cut disclosures; but I think one would be as liable to be wrong in discarding such important information as in including it, hence I adopted the latter course and am prepared to join issue with you on the point.

Notwithstanding these differences, I should be sorry to say that your articles "cease to have any value in business."

H. H. JOHNSON.

London, February 24.

[We are glad to afford Mr. Johnson the privilege of rebuttal. It gives us the opportunity of saying that his integrity was never called in question, either in mind or in writing, by us. What we did question was his independence. It seems to us that he was too complacent. Every engineer of any experience has been in a similar dilemma, when his conservative, because truthful, appraisal of the ore reserve in a mine has clashed with the optimistic, if not reckless, estimates of vendors and their agents. "The proof of the pudding is in the eating." The official estimate of the Tough-Oakes reserve is now accepted as equivalent to a gross valuation of "over £400,000" because a reputable engineer endorsed that figure. The fact that his measurements and samples only warranted him in placing the amount at £200,000 is already much in the background.—EDITOR.]

Rock Drill Economics.

The Editor:

Sir—I find that the unit of air power on the Rand (see The Magazine for February, page 141) was arrived at in the following manner: The performance of six representative steam-driven compressors was noted for a period of 12 months, and it was found that the average efficiency was 64·1%, which means that the power in the air delivered was this proportion of the power in the steam used. The commercial air unit was then fixed at 0·641 of the quantity of air compressed isothermally by one kilowatt-hour. It is an absurd unit.

HUMPHREY M. MORGANS.

London, March 6.

The Mineral Output of Great Britain for the year 1912 is reported officially as worth £131,220,853. The figures and general statistics have only just been published, as the chief inspector under the Mines Acts, Mr. R. A. S. Redmayne, only delivered his report on December 8. As we have remarked on previous occasions, these reports are getting later every year, and to us, who desire to give prompt information, it is not a congenial task to publish belated statistics. The output of coal during 1912 was 260,416,338 tons, worth £117,921,123 at the pit's mouth. The iron ore produced amounted to 13,790,391 tons worth £3,763,837. These two items accounted for the greater part of the total, and the non-ferrous metals were, as is usual nowadays, of minor importance. The output of tin concentrate is returned at 8166 tons, worth £1,012,290. At the Redruth tin ticketings the amount sold during the year, as reported in our columns, was 6492 tons worth £831,908. The difference between these figures represents the tin sold by private contract, by some of the mines, streamers, and dredgers. The output of lead ore was 25,409 tons, worth £295,614, and of zinc ore 17,704 tons, worth £87,867. Uranium ore is returned at 42 tons of a value not stated; the whole of this was obtained from the Trenwith mine at St. Ives. Of wolfram, 189 tons worth £16,590 was produced, 132 tons coming from South Crofty, 43 tons from East Pool, and 13 tons from Carn Brea. Copper cuts a small figure nowadays; the total production in the United Kingdom was only 1933 tons containing 291 tons of metal.

THE VOLATILIZATION OF METALS AS CHLORIDES.

Experimental Work done at Denver ten years ago, with results similar to those obtained at Gwalia Consolidated.

By STUART CROASDALE.

THE article by Mr. Ben Howe in the issue of the Magazine for December, giving a narrative of his experience with the volatilization process at the Gwalia Consolidated mine, is of great interest to me personally. The results he obtained at each stage of his operations are so similar to mine, described ten years ago in the *Engineering and Mining Journal* for August 29, 1903, that it might be imagined that they had been compiled from my note-books ; although it is quite evident that both Mr. Howe and myself were unknown to each other previous to last year. I feel, therefore, that a comparison of our work may be of interest, and at the same time help to substantiate the work of both. His work was confined to an antimonial gold ore, while mine covered the broader field of complex ores, particularly the gold and silver ores carrying copper, such as are always troublesome to treat in isolated districts, and also the complex lead-zinc ores.

In the article mentioned, I say, concerning the experiments on gold ores : "The ore used in these experiments varied from 80 to 20-mesh in size," and in referring to the commercial application of this process, I say : "This contact (the minerals with the salt) was accomplished by crushing the materials to an average size of 20-mesh. Some ores permitted coarser sizes and some required finer crushing. Silicious silver ores, in particular, gave much better results when crushed to 40 to 60-mesh." In my laboratory tests on Cripple Creek gold ores, I obtained 54·7% volatilization in 10 minutes, 84·1% in 20 minutes, 90% in 30 minutes, 96·2% in 40 minutes, 97·2% in 50 minutes, and 97·7% in 60 minutes. These tests were made by placing the ore and salt mixture in a clay roasting-dish and heating it in an assay-muffle. The time mentioned includes the time required for the dish and charge to attain the temperature of the muffle ; this was probably five minutes.

Mr. Howe says in an article in the *Monthly Journal* of the West Australian Chamber of Mines for December 1912 : "Ore as coarse as 20-mesh has been successfully volatilized, but the finer the ore the quicker the volatilization. Thus the same ore ground to pass 100-mesh screen is volatilized in 10 minutes, to 40-mesh in 30 minutes, to 30-mesh in 50 minutes." In his experiments on a large scale, as described in an article in the *Mining and Scientific Press* for October 4, 1913, the ore is said to have been crushed "in a ball-mill with 30-mesh screens."

To determine the true relation between the salt and sulphur for the best volatilization, I ran two series of experiments : one with a salt variation from 5 to 25%, and the other with a sulphur variation from 1·3 to 9·1%. My results proved beyond a doubt that the highest volatilization is obtained when the salt and sulphur are in the following proportions :

$$2\,NaCl + S + 2\,O_2 = Na_2SO_4 + Cl_2$$

or 4% salt for each percentage of sulphur present.

When volatile base metals, such as copper and lead, are present, and the sulphur can be eliminated to that combined with these metals, the following proportions will volatilize all of these metals together with any gold or silver contained in the ore :

$$CuS + 2\,NaCl + 2\,O_2 = CuCl_2 + Na_2SO_4$$

or for each percentage of copper 0·5% sulphur and 2% salt are required for its volatilization. With lead the following proportions hold true :

$$PbS + 2\,NaCl + 2\,O_2 = PbCl_2 + Na_2SO_4.$$

So sensitive is the volatilization to these equations that any variation in either direction with the percentage of salt or sulphur is noticeable in a laboratory test.

When only the precious metals are present it would, of course, be impracticable to reduce the quantity of salt and sulphur to a point where there would be only enough to combine theoretically, for example, with 10 dwt. gold per ton, and at the same time bring each particle of salt in a dry condition in contact with each particle of gold. For this mechanical reason alone it is seldom advisable to use less than 5% salt in commercial operations. In any case the relation to be maintained is that between the salt and sulphur, and not between the base metal and the sulphur, except in oxidized ores, where both salt and sulphur have to be added in proportion to the base metal present.

On this point Mr. Howe says: "The sulphur contents (of the ore) are about 2 to 3%," and "5% salt was added." Also: "The volatilization of the gold over this period (83 hours) averaged 92%." Had he used 10% salt for this amount of sulphur, his volatilization would have no doubt been higher, probably over 98%. He also states in the article in the *Monthly Journal* of the West Australian Chamber of Mines: "If the ore is given a rough preliminary roast before the addition of salt, 1 to 2% is sufficient for most ores; but if mixed with raw ore, more salt, say 3 or 4%, is necessary." The percentage of salt used is, of course, a problem in commercial arithmetic, between the cost of the extra salt used and the extra gold volatilized.

Again, in the treatment of gold ores where fine grinding or soaking the ore with brine would give a more intimate contact between the salt and gold mineral and would require less salt, assuming a low sulphur content, it is a question of comparative expense.

On the temperatures used, quoting again from my article of 1903, I say, concerning my laboratory experiments, that the ore mixture is "charged at once into a temperature of about 1000° C.," and with the operation of the large furnace "the ore and salt mixture is charged into the furnace at a temperature of 750° to 850° C., and finally discharges from the furnace at a temperature of 1000° to 1100° C. in practically the same physical condition in which it was charged." The physical condition of the discharged residue depended naturally on the composition of the gangue. Silicious and easily fusible ores had a tendency to slag slightly with the sodium sulphate formed. If the temperature was too high, the charge would roll into large balls in the middle of the furnace and enclose unvolatilized metal. If too low, the ore would discharge smoking with salt and metallic chloride fumes. With these types of ore the volatilization was complete when the residue discharged in small nodules of sintered material, which disintegrated after a few days exposure to the atmosphere. With more basic ores containing lime or iron, the residue discharged in a sandy condition with no sintering whatever and equally high volatilization was obtained.

Mr. Howe says in his paper in *The Mining Magazine*: "The temperature necessary for complete volatilization is orange to yellow heat—say 1000° C."; also: "We had no trouble in keeping the furnace temperature between 1000° and 1200° C."; and referring to the physical condition of the ore, he says: "The correct temperature is clearly indicated and with gas-firing is easily controlled. Should the temperature get too low, the fume of arsenic comes off in great volume from the ore as it discharges; if too high, the ore commences to frit badly, to the extent even of forming great half-molten 'blooms.' With a temperature a little higher than that actually required the ore frits slightly and has the appearance of coarse bread-crumbs—what the workmen call 'little crummy clinkers.' I found that the furnace-men preferred to discharge their ore in this form, as they were then sure that the temperature was not too low, nor is there any objection to this slight fritting, so long as it only takes place at the very end of the furnace. As soon as the ore fuses on the edges volatilization of the gold ceases."

Concerning the best type of furnace for this process, Mr. Howe found that a mechanically rabbled furnace did not expose the ore sufficiently to the air. We abandoned this type of furnace on account of the rapid corrosion of the rabble blades and arms in the highly oxidizing atmosphere filled with metallic chlorides.

Our cylindrical furnace was 25 ft. long and $2\frac{1}{2}$ to $3\frac{1}{2}$ ft. in diameter, lined with brick, and fired with oil. His furnace was 27 ft. long, 5 ft. in diameter, lined with brick and fired with gas. He says: "For this diameter the furnace should have been 45 to 50 ft. in length." My article of 1903 says: "The furnace that best meets the requirements is a revolving cylinder, 30 to 50 ft. long and with an inside diameter of 5 or 6 ft. at the discharge end."

On the necessity of an oxidizing atmosphere, the advantages of a rotary furnace, and the formation of flue-dust, I quote from my article as follows. First, in discussing my earlier work on chloridizing silver ores in a Stetefeldt furnace in Colorado during 1892-1893, and also Hofmann's work with reverberatory and Bruckner furnaces, I say: "A high volatilization was best accomplished by admitting an *excess* of air to the roasting ore, and increasing its effect by constantly rabbling the ore, or otherwise exposing a fresh surface to the atmosphere," and again, in connection with the revolving cylinder type of furnace, I say: "Heat can be readily supplied to such a furnace so as to provide the temperatures and yet allow the oxidizing atmosphere desired."

On the formation of dust, I quote again as follows: "The chemical action begins as soon as the ore has attained the heat of the furnace. As soon as chemical action begins the ore increases considerably in volume and has the appearance of being sprinkled with water. The particles adhere to each other sufficiently to prevent the formation of flue-dust, which leaves the fume perfectly clean."

Mr. Howe says in *The Mining Magazine* : " No volatilization takes place if the ore and salt are heated together with the exclusion of air. Air is absolutely necessary for the reaction, and it is therefore only in thin layers of ore immediately exposed to the air that volatilization takes place. As a rotary furnace is turning round the ore gradually creeps up the side of the furnace until it falls over on itself, ever exposing a new thin layer to the action of the air. These are the ideal conditions for good work, and they cannot be obtained in a reverberatory form of furnace worked with rabbles, because the sticky nature of the ore (due to the molten salt) prevents the rabbles turning the ore over easily. This slight stickiness of the ore eliminates that great objection to all rotary furnaces, namely, dusting."

For the settlement of the small amount of dust formed before chemical action could begin in the furnace, I expanded my flue into a small dust-chamber, but we caught very little dust. Mr. Howe used a similar chamber, which he aptly calls a 'dust-box' and baffles his dust with rods hung from the roof of the chamber. This is an excellent arrangement, but it is not a new idea. It was first developed some seven or eight years ago at Great Falls, Montana, and is now a common practice at copper smelters; but wires are used instead of ½ inch rods.

We had comparatively little trouble making a high recovery of the volatilized gold. As stated before, most of our work was on copper ores carrying gold and silver and on lead-zinc ores containing the precious metals. We also treated a number of straight gold ores. Our greatest difficulty was in stopping the copper chloride fume, so we paid little attention to the recovery of gold alone, although we did recover as high as 96% of this metal.

On the condition of the volatilized gold in the fume, I quote again from my article of 1903: " It is well known that chloride of gold decomposes at a temperature far below the temperature at which it was volatilized in these experiments (about 1000° C.), yet there can be little doubt that it was volatilized as a chloride or possibly as a double chloride with the sodium. At what point decomposition takes place is uncertain, but subsequent experiments on a larger scale (in a plant treating ore by the ton) have revealed the fact that both in the dry fume deposited in the flues near the furnace and in fume condensed by water 100 ft. from the furnace, the gold occurs in metallic form totally insoluble in water or in the acidified condensing solutions."

Henry A. Mather, in discussing this subject in the *Engineering and Mining Journal* for September 5, 1903, says: " Aurous chloride, AuCl, is first formed and volatilized, which beyond the range of furnace temperature splits up according to the following reaction:

$$3\,AuCl = 2\,Au + AuCl_3."$$

He also mentions the probable existence of a double chloride of copper and gold $AuCuCl_3$ which does not decompose until water is encountered and then completely only in saturated solutions. This latter salt, however, on further discussion in the issue of the same paper for October 17 of that year, he admits does not exist in these fumes.

In his first article he mentions the value of the presence of other chlorides to form what he terms " gaseous alloys " or " gaseous solutions," which may act in a manner similar to liquids and solids. This idea is in accord with my own views given in my article which seem to be fully sustained by experiment.

Mr. Howe says in *The Mining Magazine* : " Most of the gold appears to enter the absorption chamber in the metallic state. Some of it may be volatilized from the ore as a chloride, which immediately dissociates, while another source would be from the arsenates or pyro-arsenates formed during roasting which are split up by the salt at high temperatures, metallic arsenic being liberated. A smaller percentage of gold leaves the furnace in combination, perhaps as a chloride but more probably as a double chloride of hydrochloric acid or even sodium chloride. However, it is found in practice that in whatever form gold may exist it can be completely taken out of the fume if the latter is finely broken up in water, and in such a strongly reducing solution (consisting most of ferrous chloride) it is not surprising to find that it is all in a metallic condition and that not a trace can ever be detected in solution."

My first effort to collect the fume was by means of cotton bags. These, of course, were soon destroyed. My next attempt was by means of scrubbing-towers. These went through a number of modifications until we had a column of gravel 8 ft. high. The gravel ranged from 1 to 2 in. in size and the top was covered with 4 in. of coarse sand.

This column was sprayed with an abundance of water and the friction of the gases through the wet gravel and sand taxed the capacity of our exhaust fan. Although the gases came from the tower as cold as air from a refrigerator, the copper chloride fume was nicely washed but not condensed.

We then tried forcing or sucking the gases through filters made of burlap and sprayed with water. The final form of this apparatus was a gas-tight tower in which were fitted four horizontal diaphragms made of burlap supported on wooden frames similar to filters in cyanide vats. Over each diaphragm was a water spray. The gases were forced through these diaphragms by means of a lead-lined Root blower. They could have been drawn through just as well and it would be better to do so in practice. After starting the blower, it was possible to hold as much as 8 in. of water on each of these diaphragms, if desired, but we maintained on the average about 1 in. depth of water on each. The gases entering the lower diaphragm were broken up into as many bubbles as there were available holes in the burlap. These bubbles, of course, were so close together that, immediately on passing through the diaphragm, they collapsed from contact with each other and from the weight and movement of the water. The result was that the gases and water were agitated into a mass of foam on top of each diaphragm, after which the gases reunited, to be broken up again in the same manner by the next diaphragm with the additional advantage of being wet and cold.

Strange as it may seem, it took four of these diaphragms to completely recover the copper chloride from the gases, but with the chloride all other metals were recovered.

The water gradually dripped through the diaphragms to the bottom of the tower where it could be pumped again into the sprays, if desired, either before or after removing the valuable contents.

This apparatus, however, eventually developed a weakness in the clogging of the diaphragms by lead sulphate, basic salts, and other insoluble material, and a Root blower, even when lead-lined, was not a satisfactory machine for long continued service with corrosive gases. The difficulties just mentioned might have been minimized if we had scrubbed our gases first in a gravel tower as Mr. Howe suggests, but at that time our funds for experimental work were about exhausted and this apparatus was abandoned as impracticable although it did collect the fume.

While this method of condensation is mentioned in my original article, it is curious that Mr. Howe's work should stop at the same point with the same idea in mind. He says, "On leaving the scrubber the gases are quite cool and practically free from dust. It now only remains to break them up very finely in water before discharging them into the atmosphere. There are two methods I should recommend for doing this: (1) pull them by means of a Root blower through water causing them to bubble several times before they finally reach the blower; or (2) pass them direct into an apparatus that beats and churns the gases thoroughly with water."

After abandoning the wet diaphragm condenser we had occasion to try asbestos bags for dry filtration of the gases, but they soon disintegrated and were a failure.

A laboratory experimental plant was then equipped with a woollen bag, which was entirely satisfactory for removing the fume from the cooled gases. At the end of several months no deterioration of the fabric could be noticed from the deposited fume. Large experiments over a long period of time have not been conducted with this material and whether it will prove practicable on a large scale or not, I am unable to say.

During the past ten years I have given a great deal of thought to this fume condensation and have tried to find some reason for the difficulty we had in catching the copper chloride fume. If it required a temperature of 1000° C. to convert the copper chloride into fume, why should it not have been readily collected at temperatures of 5 or 10° C.? I feel confident now that this difficulty was analagous to that of condensing zinc vapour in large quantities of inert gases. The copper chloride, in whatever form, must have been condensed to a solid state even before it reached the scrubbing tower, but condensing as it did in such large quantities of hot, and perhaps inert gases—nitrogen, products of combustion and excess of air—the particles having no power of coalition must have been in an infinitely fine state of division, and the only way to reach them with water, as Mr. Howe and I both found, was to break the gases into a similarly fine state of division by beating them with the water into a foam or emulsion. I have seen the same difficulty experienced with lead-silver fume when making a chloridizing roast in a Stetefeldt furnace.

On the other hand, when a chloridizing roast is made in a muffle-furnace or at lower temperatures there is no difficulty whatever in condensing and collecting the fume in an ordinary scrubbing-tower, as has been commercially demonstrated for years by a company in the eastern part of the United States, using the old Henderson process.

However, after an extended experience in this line of work I would now recommend the collection of the fume in a dry condition if possible. At temperatures as low as 100° C. there is no corrosion of unprotected iron flues or fans so long as they are kept in operation, and the dry fume is much more conveniently handled in the separation and recovery of the metals even if done by wet methods.

Since our final laboratory experiment, I had never felt that the last word has been said on the use of flannel bags for this purpose under proper conditions. In this I have the support of our mechanical engineer at that time, who helped to make the test and who has had an extended experience in the use of bags at lead smelters.

However, a much more promising method of condensation has been developed since my experiments were made, and this is the use of a high-tension electrical discharge. This process has been demonstrated to successfully and cheaply precipitate fumes of all kinds from smelter smoke, ammonium chloride fume (in laboratory experiments), sulphuric acid fume from silver refineries, and dust particles from cement-kiln gases at high temperatures.

While I have not had an opportunity to try this method on the fume from a chloridizing roast, yet from the variety of products I have seen precipitated by it and from its tendency to coalesce fume under conditions which exist in gases from the chloridizing roast, there is every reason to believe it would solve this heretofore difficult problem.

The fuel consumption in Mr. Howe's experiments was abnormally high, which he explains, and then estimates that it should not be more than 16% of the weight of the ore in practice. In this I think he is correct, for our estimates of fuel consumption, based on our experimental work using fuel oil, was in the neighbourhood of 10% of the weight of the ore. Producer gas is recommended for fuel in every case for this kind of work.

It seems to me that no more convincing testimony of the metallurgical soundness of this process could be given than this independent duplication of my work from beginning to end by Mr. Howe, ten years after my work was published.

As will be seen, the greatest difficulty in both cases was mechanical, namely, securing a satisfactory apparatus for collecting the fume. I believe this can now be easily solved. Mr. Howe says his failure "was due not to any defect inherent to the process itself, so much as to the adverse conditions, local and financial, under which we laboured." The engineers of high responsibility, who watched his first experiments, could scarcely have reported more favourably than they did on the possibilities of the process.

But for the presence of antimony, which averages about 0·5%, the ore seems to be an ideal one to treat in several ways, and not necessarily by volatilization, although that seems entirely feasible. Singularly enough a writer in the *Mining and Scientific Press* for October 4, 1913, states "this ore, containing antimony, even in the upper levels, has resisted the best known metallurgical methods to give a reasonable extraction" except by volatilization, while my experiments on volatilization gave their *only* erratic results with antimonial silver minerals. So far as I know, we tested no gold ores carrying antimony in appreciable amounts.

[For the benefit of those readers who may not have access to the *Monthly Journal* of the West Australian Chamber of Mines, we may mention that Mr. Howe's article therein was quoted fully in *The Mining Magazine* for March 1913 and the *Mining and Scientific Press* for March 29, 1913.—EDITOR.]

Tin in Alaska.—Tin-dredging has been continued in the York district near Bering straits during 1913. Lode-tin is worked on Lost river in the same district and a concentration plant has been erected. Prospecting is being done at Ear mountain. Placer-tin has been mined at Hot Springs and lode-tin has been found in the same region.

Broken Hill Production.—The report of the customs department of New South Wales publishes the following figures relating to the deliveries of Broken Hill mineral products over the border into South Australia during the year 1913:

	Long tons.
Silver-lead concentrate	327,431
Zinc concentrate	405,740
Silver-lead ore	24,754
Silver-lead slime	10,036
Zinc slime	1,606
Total	769,567

The classification is based on the differential railway rates for various products.

MINING IN THE MALAY STATES.

The Country and its Government. Geology of the Tinfields. Methods of working the Deposits. Labour Conditions.

By MUNGO PARK.

Introductory.—Of late years a number of books dealing with British Malaya have been published, including two excellent Federated Malay States handbooks. Elaborate descriptive information is thus available concerning this country in its different aspects. The Malay States Information Agency has also furnished recently a short brochure on mining in Malaya. The latter, a well written and attractive booklet, authoritative in every way, is from the pen of Mr. F. J. B. Dykes, formerly head of the Government Mines Department in the Malay States, and contains an interesting preface by Mr. Reginald Pawle.

It is difficult therefore to avoid covering old ground when writing about Malayan mining. An attempt has been made, however, to manage this, and to make the present article as original as possible. These notes, purporting to be supplementary to what has already been written, may be sometimes 'sketchy' concerning points of interest; in such cases detailed information can be found elsewhere.

It has been necessary in the geological part of the article to retail the essence of a story that has already been told, most ably, in the papers and memoirs of Mr. J. B. Scrivenor, the Government Geologist. Although it has been impossible to evade the inspiration of the latter, the notes in this part of the article are mostly the result of personal observations.

Government. — The Federated Malay States Protectorate comprises four adjoining Native States in the Malay peninsula: Perak, Selangor, and Negri Sembilan on the east, and Pahang on the west coast. The four States form provinces of the Federation, under the rule of their respective Sultans, the provincial administration being conducted by a British Resident, and a staff mainly composed of British officials. The State administrations are directed by a central federal head known as the Chief Secretary, who, assisted by a large staff of expert advisors, is the executive officer of the Protectorate. The Chief Secretary was formerly known as the Resident General; he is responsible to, and is supervised by, a High Commissioner, who sees that the administration is in accordance with the policy of the Imperial Government. The change of title from Resident General to Chief Secretary was carried out in order to emphasize this control by the High Commissioner, who has always been hitherto the Governor of the Straits Settlements for the time being.

Legislation is in the hands of an assembly known as the Federal Council. The latter at present consists of the High Commissioner, the Chief Secretary, the Sultans and Residents of each State, the legal advisor of the Federation, and five unofficial members appointed by the Government.

The four States are divided for executive purposes into districts of various sizes, over each of which a District Officer presides; he is ex-officio collector of land revenue, and to him application must be made by those requiring land for mining or agriculture. The District Officer usually resides in the chief town of his district and is chairman of its municipality. He is also the chief local magistrate and governor of the prison, but his main duty is to act as a land-agent for the Government, and to keep the latter advised on all matters concerning the welfare of the district under his supervision.

The District Officer is generally assisted by one or more Assistant District Officers, and each district usually possesses a Resident Officer of the several Government professional and technical departments, such as the Medical, Survey, Forest, Police, and Mines officers who carry on their work in the district under instructions from the State or Federal heads of their departments.

The Mines Department is represented in Perak by a Warden and an Assistant Warden; in Selangor, by a Warden; in Pahang, by two Assistant Wardens; and in Negri Sembilan, by an Assistant Warden of Mines; while a federal officer, the Senior Warden of Mines, is head of the department and exercises authority in all four States. The work of this department, which consists principally in enforcing the provisions of the mining enactments and in advising the Government on matters connected with mining, is carried out locally in the districts by Inspectors of Mines, who are assisted by educated native subordinates known as Mines Overseers.

Inspectors of Mines are always selected by the Colonial Office from graduates of recognized mining schools.

Each district has also one or more resident P.W.D. officials, the province of the Public Works Department, for which these initials stand, being the construction and maintenance of roads, bridges, state buildings, and other Government undertakings, except the railways, which are owned by the Federal Government and are managed independently. The Survey Department is manned by qualified surveyors ; a number of these are engaged in a triangulation survey, but the majority are employed in demarcating and preparing Government leases, all areas alienated being accurately surveyed before a lease is issued. The latter survey is carried out by traversing with a theodolite, and each station point of the traverse is marked on the ground by a small concrete or metal beacon.

The Medical Department has the government hospitals under its charge. In these hospitals, one or more of which are in every district, free attendance is given to those patients who cannot afford to pay for treatment. This department is also largely occupied with public health work and assists in preparing and giving effect to measures for the extirpation of disease.

The Forest Department has charge of the forest reserves, areas which have been withheld from alienation for mining or agriculture on account of the occurrence of some economic jungle product such as hardwood, camphor, or gutta percha within the reserved section. Latterly a number of reserves have been located between cultivated areas to act as protective belts against the spread of agricultural pestilence. Forest Reserves are practically closed to mining and prospecting, a fact which is deprecated by some of the mining community, who consider that the reported mineral contents of some of these reserves might prove more profitable to the State than the jungle products conserved.

A reservation, however, may be cancelled at any time should the Government consider such a policy to be justified by proof of mineral resources within it.

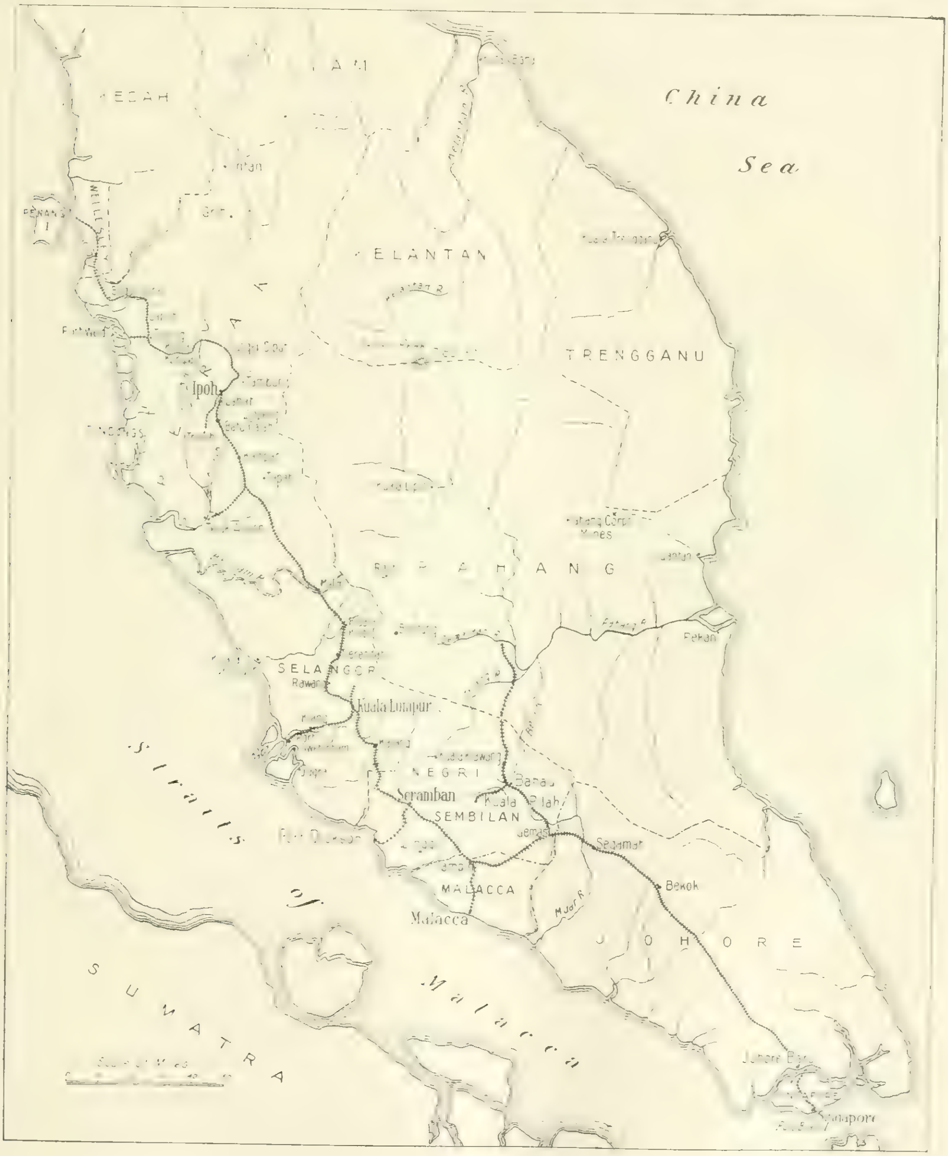
Two other departments are of special interest, the agricultural and geological, the former having been formed with the object of helping the agricultural, and the latter the mining, population. The Agricultural Department is now a well staffed department whose assistance is greatly appreciated by the planters. The Geological Department is unfortunately quite disproportionate to the importance of the country's needs. For many years the staff consisted only of one European geologist, with a Malay rock-collector, and a native clerk. Within the last two years, another geologist has been engaged and further additions to the department are contemplated. In consequence of this inadequate staffing only two outline geological maps have been prepared, one of which covers two districts in Pahang and the other a district in Perak.

Although, for the reasons given, the mapping results so far are small, valuable work has been done under considerable natural difficulties. In addition to the general help given to the Government and public in economic geology, some excellent memoirs have been prepared, and many prospectors have reason to be grateful for ever-ready help in the identification of rocks and minerals. In the future it is to be hoped that while general geological work is conducted on the same useful lines, the fundamental task of mapping the country will be expedited.

In addition, there are many other sections of the executive dealing with trade and customs, post-office, education, and so forth ; there are also a number of officers employed in the legal and judicial work of the administration, whose functions need not be described in detail.

The departmental system, it will be seen, is well organized. The usual bureaucratic anomalies may be observed ; here, a boy doing a man's work, there a man performing a boy's ; here, need for centralization, there, decentralization required ; here, two departments overlapping and the same work twice done ; there, work which seems to be nobody's province neglected accordingly. On the whole, however, the result is an administrative machinery that works with a certain clumsy efficiency and tardily satisfies the needs of the country. The technical and professional officials are recruited by selection ; the non-technical administrative staff is chosen on the results of competitive examinations in England. The results in both cases are satisfactory. The Government men, 'company *punya*' as they are termed locally, vary greatly ; individually, they may be painfully conscientious or pleasantly happy-go-lucky, postponers or hustlers, well meaning, well educated, or well-thought-of, stiffly dignified, or hail-fellow-well-met. Taken collectively, however, they are keen and interested in their work, generally applying a lot of common sense to its performance. Readily accessible to all, they are usually courteous and considerate, and their conduct is just, upright, and impartial.

The machinery and personnel of the Government being now outlined, it is interesting to consider the circumstances under which they act and the conditions to which they are required to conform. The Malay States Government is in a sound position financially. As a result of prudent expenditure, the Federation possesses a number of internal assets of considerable value. Government ownership is wide and varied; among its trading ventures are hotels, steamers, and motor-buses; among its social and philanthropic efforts are hospitals for the sick, hill stations for the convalescent, and clubs, race-courses, bands, and playgrounds for the vigorous. Its biggest internal enterprise, however, is the railway system. The amount spent on railway construction till the end of 1911 represents a capitalized sum of over £6,000,000. On this sum the profit in that year was equivalent to a 6% dividend.



MAP OF THE FEDERATED MALAY STATES.

A more striking feature of the country's finances is the fact that the States have a public credit of about £6,000,000. A portion of this is on deposit in the banks, but the bulk is either invested in funded securities or loaned to neighbouring governments. Some of these loans have been severely criticized; and there are critics who, not content with deprecating the investment of this reserve fund outside the Federation, advise the Government to borrow money from Europe for further internal development. However sound some of these criticisms may be from a financial point of view, the fact remains that directly or indirectly the Malay States gain politically by investments in neighbouring countries, and are probably wise in not allowing outside financiers any excuse or opportunity for interfering with their domestic affairs.

Finally, the State is the only freehold landlord, all landowners holding their properties under terminable or perpetual leases from the Government, and paying an annual rent for their title to possession. This rent is usually small enough, ranging from 2s. 4d. per acre for mining and certain agricultural lands to about £2 per acre in the case of town lots. In 1911 the land revenue derived from rentals amounted to £200,000, and statistics show that at the end of that year 2774 square miles of land were alienated, 452 square miles being leased for mining, and 2322 square miles being leased for building or agricultural purposes. The area alienated and the revenue received show that the State rental averages between £70 and £80 per square mile. The total approximate area of the peninsula has been estimated at 27,500 square miles, so that the land leased by the Government is only about 10% of the total area. If the area of Forest Reserves (1160 square miles) is added to the leased areas, there remain 23,500 square miles available to applicants for mining or agricultural leases.

It must be remembered that the last figure includes mangrove swamps, river bottoms, and mountain peaks, for which a deduction may be allowed; and also that most of the land adjacent to the railways and main roads is already occupied; but when all allowances are made, there remains a large area of available land, with considerable potentialities.

The Government is ready to lease unoccupied areas to desirable tenants for mining, planting, or other purposes; a desirable tenant being a lessee who fulfils his undertakings in good faith. In fact, a part fulfilment of the latter is usually made a condition. For instance, the lessee of a mining area is compelled to start work within six months of lease issue, and afterward has to maintain a labour force of one coolie per acre on the land. Agricultural lessees have to commence cultivation within a year, and to have a quarter of the total area under cultivation within five years.

In the case of mines using hydraulic installations or machinery, one horse-power is considered to be equivalent to eight coolies. These rules are not interpreted in a harsh or stringent manner. When a tenant fails to fulfil the labour and cultivation clauses, he is usually asked to show good cause for the non-observance of his contract, and the Government is readily satisfied if a reasonable explanation be forthcoming. However, it may be understood that the Government will not encourage two classes of land applicants, the applicant who seeks land to utilize as a counter for speculation, or the applicant who endeavours to secure land for the purpose of obstructing a neighbour. The cultivation and labour clauses hinder the latter class of applicant, who is further deterred by the rules of the various enactments framed to prevent friction or obstruction between neighbouring owners. In the case of mining land, anti-obstruction regulations are specially necessary because owners of mining areas are often compelled to allow their tailing to be water-borne to dumping grounds at considerable distance, and have sometimes to operate with water-power conveyed from an intake several miles from the mine. It may be seen easily that land occupiers on the route of a pipe-line, or on the site of an inevitable dumping-ground might control the situation. To prevent this the Mines Department is empowered by enactment to over-rule obstinate opposing interests by preventing dumping on profitable areas, or enforcing it on land described as 'worked out,' without considering the question of ownership. The Government also can construct, or permit others to construct, roads, railways, or waterways through any property, and can arrange for the payment of reasonable compensation for damage caused by such construction. The fact that arbitrary authority is thus delegated to certain officials serves as a basis for trenchant criticism of the mining laws in a published book on Malayan mining. It may be remarked that such authority is only exercised under circumstances similar to those described when its exercise is necessary for the prevention of obvious injustice.

Land available for tenancy is divided into two broad classes: mining, and agricultural or building land. Mining is not allowed on land leased for agricultural purposes without the sanction of the Ruler of the State in Council. This sanction to change an agricultural into a mining title is not easily obtained. The fine charged for the conversion is never less than the usual mining premium of the district, and is usually much heavier. There are probably two reasons for this, namely, the undesirability of allowing applicants to obtain large mining areas under a pretence of cultivation, and the theory that when cultivation is abandoned in favour of mining operations the State loses a permanent asset in favour of a temporary one.

IN THE MALAYAN BUSH.

The financial conditions of the country show this latter theory to be economically unsound,* and, with prospectors and genuine discoverers suitably encouraged or rewarded such subterfuges should be obviated. It is to be hoped that with the expansion of the Geological Survey alienation of agricultural leases on mineral-bearing land will cease to exist.

Application for land is made to the Collector of Land Revenue, who reports to Government on the applications received. Where numerous applicants want the same piece of land, the latter is usually auctioned. Should the Government consider it equitable or advisable to allot an area to any particular applicant, a premium is charged. This premium in the case of agricultural lands is 7s. per acre for land with a road frontage, and 4s. 8d. without. In the case of mining land the premium is 23s. per acre unless the Resident directs otherwise. On the Resident's direction, however, any price may be demanded, and in certain cases as much as £200 per acre premium has been paid.

The cost of surveying must be deposited when the application is made. The survey fees are rated on a varying scale: for a 10-acre lot it is £3; for a 100-acre lot, £21; and for a 1000-acre area, £110.

The names of all lessees, as State tenants, are naturally recorded in the Government registers. A transfer, mortgage, or sub-lease is a comparatively simple matter. The parties interested notify the Collector of Land Revenue

* A rough comparison can be made by assessing capitalization on a basis of 20 years' purchase, and assuming that the lessee receives one quarter of the gross revenue or receipts as profit. In such a case, if the lessee received a profit of $100 per annum from agricultural operations, the capitalized value to him of that acre would be $2000. The annual Government royalty on the product would be $10, equivalent to 2½% on a gross annual revenue of $400. The capitalized value of the latter to the Government would therefore be $200. The lessee would never make the change unless he was assured of a mining profit of at least $2000; the latter result would mean $800 to the Government with a mineral duty assessed at 10% on gross receipts of $80,000. (The dollar is worth 2s. 4d.)

of their intentions on a prescribed memorandum form. This memorandum, which must be duly signed and attested by the parties, is filed in the Land Office, and notes of the transaction are recorded in the Land Register and Document of Title; after which the latter document is returned to the person entitled to its custody.

Land tenancy need not include water-rights. There is no riparian ownership in Malaya, the entire property in, and control of, rivers and streams being vested in the Ruler of the State. Water for mining purposes is granted under license on the authority or recommendation of the Mines Department. No charge is made for water used for mining or power purposes.

Prospecting licences are granted over unalienated land for periods ranging from three months to a year. The charge for these licences varies from £3 to £20 or more, according to the area and position of the land.

The licence grants exclusive prospecting rights within a defined area, and on completion of a reasonable amount of prospecting the licensee can make a selection of the land within this area for mining purposes. The acreage of selection area required, which need not necessarily be in one block, is specified on the Prospecting Licence. A Mining Lease is granted for the area finally selected. An application for a Prospecting Licence is usually delayed, while the Government considers the application in all its bearings. These Prospecting Licences exactly meet the requirements of an applicant who desires to test or investigate an area known to be mineral-bearing; they are of less assistance to the explorer seeking to discover new mineral lands, and for this type of prospector no provision is made at present, in the shape of discoverer's rights, or rewards for the notification of new deposits of commercial value.

The land policy of the Government has proved both wise and beneficial. It aims at dividing the States into fixed surveyed centres of active industry rather than large concessions, vaguely defined, on which desultory work is performed. In this respect the Malay States present a strong contrast to certain other colonies and protectorates, where the map has been partitioned for the benefit of European concessionaires. Valuable work is sometimes done by certain concession syndicates; but often the paper area is the subject of paper amalgamations, paper flotations, paper deals, and paper exploitation generally, while the actual land lies undeveloped, unproductive, smothered by paper. In Malaya, the settler or resident finds that his opportunities are not sacrificed to gratify the rapacity of land monopolists, the native has his heritage guarded, his conditions bettered, and the Government gains power and wealth, equipping it for any tasks that the future may require.

Looking ahead, several enterprises may be perceived that need attention from the Government and require the expenditure of large sums of money. The Government has put in hand a general scheme of railway expansion; and the road system will need to be extended *pari passu* with the growing development of the States. The transhipping accommodation at Port Swettenham is already becoming inadequate to the requirements of the country's sea-borne trade, and the Government is preparing for the enlargement of the port accommodation. Special endeavours are also being directed to the prevention and abolition of disease. It is now universally known that malaria and certain other illnesses that scourge tropical countries are transmitted by the bites of suctorial insects. The extermination of the mosquito is proving difficult and expensive, especially in Malaya, owing to the discovery of malaria-propagating varieties of mosquito that breed in running water. The importance of the effort and the success that has already followed work of this kind, especially in Panama, are incentives to perseverance, and there is no doubt that a lot of money will be spent in this direction during the next decade. The States have built, equipped, and staffed an Institute for Medical Research at Kuala Lumpur. Research by doctors inside and outside the latter, regarding the stiology of *beri-beri*, has succeeded in demonstrating the cause of this disease, so widespread and so serious in the East.

Educational facilities need consideration, more especially those connected with the technical side of this subject. The equatorial belt cannot be considered a 'white man's country,' and accordingly Europeans, when required to reside there, demand a much higher wage than would content them in a temperate climate. In consequence, skilled European* labour, except for higher appointments of supervision and administration, is generally inadmissible on the ground of expense. Unless technically trained youths are educated in Malaya, it becomes necessary to import this class of employee from other parts of the tropics. The success attendant on the

* The term European in the East includes the civilized races of America and Australia.

introduction of technical training in Japan shows how amenable the Eastern races are to this form of teaching. The Government Medical Schools at Singapore have also done good work, and it is proposed to provide for technical and scientific education in the States. The scheme so far has been prosecuted in a rather lukewarm manner, and has been received somewhat apathetically. The success that now attends the application of technical training in the various fields of industry, and the inroads of scientific education and direction during recent years into the labour centres of civilization, are not perhaps fully realized by those who live on frontiers.

used weight equivalent to 400 lb. avoirdupois.

A crude and awkward mixture of Chinese and English weights and measures are in use. The employment of the metric system began and ended with the metre-gauge of the railways. It is unfortunate that some better arrangement was not adopted. *Simplicity and accuracy are now lost in the Land and Survey Offices by returning each lease as so many acres, roods, and poles, and the railway annually furnishes a meticulous return showing how many tons, hundredweights, quarters, and pounds of coal have been burnt during the year.

When the value of the Straits dollar was

Limestone outcrop at Kuala Remau.

As a last instance of the expensive schemes awaiting the Government, the provision of a hill-station may be cited. Ceylon, Java, and the Indian Presidencies all possess hill-stations where the white inhabitants can easily and cheaply obtain the beneficial change of climate often so desirable in hot countries. At present in the Malay States this can only be obtained in a few scattered bungalows difficult of access. A survey is now being made of the Tahan plateau some 6000 feet above sea-level, with a view to the planning and completion of a health resort.

A large amount of the annual revenue of the Federation is due to the export duty on tin. The latter, which is now about 13% is rated by means of an unhandy sliding-scale based on the price of tin per *bhara*, a little

fixed a few years ago, a good opportunity occurred for rating the latter at 2 shillings, and so making it a decimal equivalent of the English pound sterling. Unhappily, for financial reasons, it was considered advisable to standardize this coin at 2s. 4d.

The duty on wolfram or scheelite is $2 per pikul, the latter weight being about 130 lb. Gold is charged a 2½% export duty, and other minerals 10% *ad valorem.*

Geology.—One of the chief physical features of the Malay States is a mountain chain that traverses the peninsula from north to south, dividing the latter into two equal por-

* The truth of this statement may easily be seen by comparing the simplicity of the two statements, 12·375 acres at $10=123·75 dollars, and 12a. 1r. 20p. equals a similar amount. As far as accuracy is concerned, the former statement shows measurements to one-thousandth, the latter to the one-hundred-and-sixtieth of an acre only.

tions, the larger of which lies to the east. The summit of this ridge, whose peaks stand from 3000 to 7000 ft. above sea-level, forms the boundary between Pahang and the Western States and is the main watershed from which streams flow westward to the Straits of Malacca or eastward to the China Sea. Geologically this ridge represents the denuded crown of an anticline. The crest of the ridge consists of granite, which originally formed the core of the anticline. With the exception of some quartzite peaks on the Perak boundary no trace of the crown remains, but outcrops of the different strata representing the anticlinal limbs may be met by descending the ridge on either side. The formation of this anticline was probably contemporaneous with the period of granite irruption. The granite is believed to be of late Mesozoic age and is younger than most of the sedimentary formations, which in most cases have been considerably metamorphosed by the movements that occurred with, and followed, its irruption. There is evidence that a considerable amount of faulting and disturbance took place during the cooling of the granite, and it is probable that minor earth movements have been continued nearly up to the present day. In places along the edge of the granitic mass these movements have buckled the original beds of shale and sandstone so that they form foot-hills of crumpled schist and quartzite, and have faulted the limestone beds with the formation of the precipitous bluffs that are a prominent feature in some of the tin-mining districts.

In addition to the large granite mass of the main range, other granite intrusions outcrop in the eastern and western States, the most notable of which, Benom Range in Pahang, seemingly another denuded anticlinal crest, has a summit nearly 7000 ft. high. The granite shows signs of post irruption movement; in Pahang some of the granite outcrops have been cut by dolerite dikes, probably of Tertiary age. The mass is often traversed by veins of quartz, pegmatite, kaolin, and greisen, probably due to pneumatolysis taking place along fracture lines. These veins seem generally to strike east and west.

The main range granite is of a distinctly acid character. A common type contains large white crystals of felspar. Tourmaline and cassiterite are often found, and sometimes the impregnations of the latter mineral are exceedingly rich.

The outcrop may be heavily weathered, the weathering sometimes penetrating to a depth of 50 ft. or more. The granite, when thus weathered, is exceedingly soft and friable, allowing it to be easily mined by alluvial methods, so that many so-called alluvial mines are really mining tin ore in place.

The weathered granite has a mottled red appearance due to the liberation of free iron oxide, and closely resembles some of the alluvial clays. The metamorphic and sedimentary rocks also commonly weather to mottled sandy clays of similar appearance, so that the recognition of the various outcrops is rendered difficult to an observer unfamiliar with the formation. This intense weathering may possibly be caused by organic acids formed by the lavish growth of plant life incidental to the warm moist tropical climate. Mention has already been made of the ease with which weathered granite can sometimes be mined. A similar facility obtains in regard to certain stratified rocks. Several mines are engaged in working tin-bearing veins in the schist by hydraulic methods. The Government Geologist mentions a case, where, owing to weathering, a once hard conglomerate had been reduced to a consistency of cheese without any disturbance of the position of the pebbles. Besides softening rock for mining, the general weathering has resulted in the production of a large quantity of laterite, which is extensively used for road metal, and which occasionally contains sufficient tin to enable it to be worked profitably as a tin ore.

Parts of the granitic mass resist weathering and remain as core-boulders; these boulders are a marked feature in the valleys of the main range. Their presence is a hindrance to prospecting, as they cover and conceal the exposures of bedrock made by stream erosion.

The granite of the main range is of great economic importance. It remains the ultimate source of most of the tin produced in the Peninsula. Very little prospecting has been done on the higher parts of the range, owing to present inaccessibility and lack of water. Recently, however, valuable deposits have been discovered on the Pahang-Selangor boundary at an altitude of over 4000 ft., and probably further discoveries will be made when more attention is given to the possibilities of this mountain land.

The principal stratified rocks are the Raub series (Carboniferous) and the Gondwana rocks (Trias), which outcrop over large areas. The Raub series is mainly calcareous. To this belongs the limestone, whose pinnacled surface forms the bedrock in the well known Kinta valley and which is here and there conspicuously prominent, rising in bare white cliffs, the precipitous faces of which are sometimes nearly 1000 ft. high. The limestone occasionally contains obscure coral and crinoidal fossils.

An interesting feature about the limestone is the occurrence of pipes containing profitable deposits of tin ore. The ore occurs with a calcite gangue, and is usually accompanied by minerals such as limonite, fluorite, chalybite, and pyrite, mispickel, or other sulphides.

From an economic point of view this series is also important as forming the 'country' of most of the auriferous lodes in Pahang.

The Gondwana series appears in the tin districts as beds of quartzite and phyllite.* This formation is well developed; in Pahang the Tahan mountain peak, the highest in the southern peninsula, being composed of these rocks. In places they constitute the 'country' of tin-bearing lodes and stockworks. Mention has already been made of the ease with which some of these lodes can be hydraulicked near the granite contact, owing to heavy weathering.

Other geological formations of interest are the Gopeng beds of Perak, the Rantau-Panjang beds in Selangor, and the Pahang volcanic series.

The Gopeng are detrital deposits that occur near Gopeng in the Kinta district. This formation rests upon the limestone, the granite intruding into the beds, which are composed of boulder deposits and beds of clay. An item of interest is the occurrence of boulders of corundum, some of the latter having been found exceeding 80 lb. in weight. The Government Geologist believes these beds to be of glacial origin, and to be contemporaneous with the Permo-Carboniferous drift of India, Africa, and Australia. These beds are extensively mined for tin, by some of the largest hydraulic companies in the States.

The Government Geologist adduces good evidence to show that a large portion of this tin was deposited by the original glacial action, though a considerable amount of secondary enrichment has taken place through pneumatolytic action following the granite intrusion.

The Rantau-Panjang beds occupy a small basin situated about 10 miles from Rawang in Selangor. They are Tertiary deposits lying uncomformably upon the Gondwana rocks, and consist of beds of lignite, shale, and silicious clays. Leaf fossils have been found. The largest seam of lignite is about 50 ft. thick; it is of excellent quality and should prove an asset of some value in meeting the increasing demand for fuel in the Peninsula. The formation has been carefully prospected, and a company has recently been formed for the purpose of opening a colliery. An interesting feature is the occurrence of small quantities of oil, which can be obtained by distilling the shale.

The Pahang volcanic series consists principally of beds of lava and ash that are widely distributed in Pahang. It has been suggested that the occurrence of gold in Pahang may be genetically connected with the irruption of this series. From present indications there seems no likelihood of any mineral industry of importance being commenced on the series, but the soil covering the ash and lava outcrops should have agricultural value. It is to be hoped that the Government will try to divert intending cultivators from granitic tin-bearing lands and direct them to these fertile volcanic soils.

The various stratified and igneous rocks are covered in places by deposits of recent origin. As might be expected, the various river gravels and terraces and the recent alluvials of torrential origin nearly all contain tin, and many stream-valleys whose source is in the main range are centres of alluvial mining activity. In the coast districts of Selangor the surface formation consists principally of a recent deposit of blue clay, possibly a former marine littoral, whose present inland position is due to a westward advance of the coast line. Bores sunk for water in this clay usually liberate marsh gas, and water obtained is usually salt and unpotable.

With the exception of the small gold mining focus in western Pahang, tin mining almost monopolizes the mineral industry in the Malay States. Wolfram, which occurs under conditions similar to cassiterite, is mined in many places, and increasing attention is being paid to this mineral. Scheelite, another tungstem ore, is also found. Monazite occurs, but so far has not been worked commercially. At Batu-Caves in Selangor the limestone is quarried for cement manufacture, and it has also been used at Ipoh for ornamental stone-work. Both the granite and limestone are extensively quarried for road-making.

The Geological Survey staff is now being increased and the mapping of the country, hitherto perforce somewhat localized, should be extended. Present railway and road extension is opening up large tracts of country hitherto inaccessible to mining. There are

* See also this Magazine. June 1913. Page 404.

therefore promising opportunities of finding fresh mineral deposits in the future and possibly of adding new mineral industries to those already established.

Working Detrital Deposits.—Various methods of mining are adopted to suit local conditions, the principal determining factors being: the size of area to be worked, the amount of capital required, the quantity of water available, the richness of the deposit, the relative distribution of ore and overburden, and the facilities for drainage and the dumping of tailing.

If the land to be worked has natural facilities for draining and dumping, some form of hydraulic mining is nearly always adopted. Monitor and pipe-line installations are employed where the area and the capital are sufficient to justify this method. Smaller areas are worked by ground-sluicing. Wherever it is possible to secure water under natural head, flumes, ditch-lines, or pipe-lines are constructed to utilize any potential energy available. Where water under a natural head cannot be obtained, energy is supplied by means of pumps. In the larger installations the motive power for these may be obtained from electric, oil, or gas plants. Small ground-sluicing mines usually employ a portable boiler and engine driving a centrifugal pump. Permission from the Government is necessary before hydraulicking or ground-sluicing can be started. Before the permission is granted, the Mines Department must be satisfied that suitable arrangements are made for the disposal of tailing and that no more than an equitable share of available water is required.

On flat land where there is no natural outfall for drainage and tailing, hydraulicking becomes less advantageous because the tailing and surplus water have to be removed from the workings by means of gravel-pumps or hydraulic elevators. In consequence, other methods, such as mining by open-cut haulage, by bucket-dredging, or by underground excavation have to be adopted.

In hydraulicking, all the ground from the surface to bedrock is usually treated; so that, in common with bucket-dredging, it is a method suitable for areas where the ore is more or less evenly distributed between bedrock and surface. As the ground is thoroughly puddled and disintegrated by the monitors in the act of removal, it is probable that a higher extraction of the metal content is obtained by hydraulicking than by other methods, particularly when the alluvium is at all clayey. Occasional boulders and irregularities in the bedrock floor, detrimental to bucket-dredging, are minor impediments in hydraulicking. This system also has the advantage over bucket-dredging that the installation generally consists of less heavy and bulky units, and can therefore more easily be introduced into relatively inaccessible areas. Owing to the advantages described, the method of hydraulicking and elevating has proved highly successful under favourable conditions and a number of mines have adopted this means of working low-lying alluvial flats.

The bucket-dredge is admirably adapted for working below the level of surface-water when the latter cannot be easily drained or pumped. Therefore bucket-dredging offers a most favourable method of working swamps, river-beds, or other water-logged areas. The alluvium preferably should be of a sandy or friable nature, should have an even bedrock, and should be free from boulders. Only a few dredges are at present employed in the Malay States, but the working results of these are satisfactory, and their number is likely to be increased.

Open-cut mining is more selective than the two last methods, and shows to best advantage where a tin-bearing deposit is overlain by a worthless overburden. The former alone requires to be washed, sometimes an important consideration when the supply of water is limited. The open-cut system does not require a large capital outlay and the mine can be brought to the producing stage rapidly. These economic advantages have caused this method to find favour with some mine-owners, and in consequence it has sometimes been adopted or retained on mines probably large enough to justify more efficient methods of working. Areas too small to justify expensive power-plants are naturally worked in this manner.

A crude system of working the alluvium by underground methods is sometimes adopted on hillsides that cannot easily be ground-sluiced, or on flat land where the overburden is of disproportionate thickness. The method consists of sinking numerous small pits and removing the adjacent tin-bearing gravel in baskets with a windlass. This method yields a portion of the metal content with a minimum of capital outlay. It is, however, wasteful, as a lot of ore is left behind, and occasionally the latter is extracted at a profit by subsequent open-cut workings.

The lode-tin mines of the Pahang Consolidated, and the mines of the Raub company are worked by the usual methods, with large hoisting shafts, drifts, and stopes.

Population and Labour.—The population of the Malay States as taken at the census in 1911 was:

Europeans	3,284
Eurasians	2,649
Chinese	433,244
Malay Races	393,622
Sakais	27,218
Indian Races	172,465
Other Races	4,517
	1,036,999

HYDRAULICKING TIN ALLUVIUM.

It will be seen that the Chinese are the most numerous race in the Federation. In the year 1912 there were 201,208 Chinese labourers engaged in mining. The latter as a class are quiet, docile, and industrious. They are also exceedingly intelligent, and some of the Chinese coolies exhibit remarkable characteristics of strength and endurance.

These characteristics give them many of the qualifications of the ideal labourer, when they are controlled by some one accustomed to dealing with them. On the other hand, it is often hard to get them to follow instructions implicitly, especially when they think they can improve upon the orders given to them. Moreover, the Chinese coolies, having been often cheated, are apt to be irritatingly suspicious of their employers when they are first engaged. This suspiciousness, which frequently takes the form of demanding advance payments before starting work, is not less noticeable when the employer happens to be a European. In explaining the latter attitude, it should be noted that while the majority of European officials and the bulk of commercial employers are men of strict integrity, deeds are often done in their name that they "wot not of." It is also not surprising in a country like the Malay States, where every coolie is a potential millionaire,* that the labouring classes have sometimes a slightly exaggerated idea of their own usefulness and importance. Finally, it must be remembered that the intelligence of the labourer may be directed against an unpopular employer as readily as it may be used in the interest of a popular one. When these considerations are taken into account, it may easily be understood that, under certain circumstances, the employment of this admirable labour may prove a doubtful success.

Other Chinese characteristics may be noted.

* Many instances of mining coolies becoming wealthy men are known.

They are frugal and thrifty, and this trait continually makes its appearance in the industries where they are engaged. In their open-cut workings, trestle-ways may be seen just strong enough to bear, just wide enough to walk on, and just permanent enough to last for the time they are required. The Mining Inspector, questioning the strength of a dam, whose bursting point seems more imminent than desirable, will be told "boleh tahan," meaning that it will serve, a phrase commonly used to reassure the European accustomed to solidity and factors of safety.

The Chinese are subtle, and although to European minds straightforwardness and simplicity have become more or less synonymous with honesty, they, with upright intention, take part in the most involved and ramose transactions as a matter of everyday custom.

They are prudent but not unduly cautious; in fact, anything in the nature of a speculation or gamble appeals to them strongly. They have the quiet enterprise of Scotsmen. They also possess in a marked degree another reputed Scottish attribute. The Chinese are so clannish that they regard others possessing the same surname as members of their family; such a connection, in fact, is a bar to marriage. Their tendency to form cliques occasionally leads to riots, as an altercation between two individuals of separate factions may be extended owing to members of the respective factions adopting the quarrel as their own. The strong racial characteristics of subtlety and clannishness may also be turned to bad account by secret societies formed for marauding, brigandage, or other evil purposes. It has been proved necessary for the Government to take firm steps to ensure the suppression of the latter, and membership of any such society is now punished by banishment from the Peninsula. On the other hand, many of the most sensible ideals of the white races are equally the ideals of the yellow races, and no notes about the Chinese are complete without reference to their sense of gratitude: a most marked and pleasing characteristic.

The principal Chinese tribes engaged in mining are the Cantonese and Khehs, with the Hokkiens making a good third. Other races represented in some numbers are the Tie Chius from Swatow and the Hailams from the island of Hainan. The latter are principally employed as domestic servants.

If the Chinaman represents the Scotsman of the East, the Irishman has an oriental equivalent in the Malay. The Malay as a red kris'd Romeo, or sentimental pirate, appears in the caste of many novels and poems treating of the East. The romantic halo thus cast over him perhaps accounts for the attitude of certain Europeans, who seem to regard and treat him more as a pet than as an employee.

The Malays are usually obedient to authority, respectful and dignified, especially when they live in their villages away from the larger towns, which tend to produce a somewhat parasitic type. They are usually courteous and pleasant little people, in this respect sometimes forming an agreeable contrast to the more ignorant classes of Chinese, who are often sullen and ill mannered.

They are highly intelligent, and some Malays are excellent workers. The latter are however exceptional, because the Malay is commonly either a lazy or capricious toiler.

Only 2340 Malays were engaged in mining in 1912. The Malay however occupies a more important position than this figure shows, on account of the number of them indirectly connected with the industry, and because these actually working in mines are largely employed as monitor-men, engine-drivers, survey-assistants, and other positions that are relatively more important than that of the ordinary coolie.

As a race, the Malay is extremely improvident; money "burns holes in his pockets" and unfortunately sometimes he is apt to treat other people's property in the same free and easy way that he treats his own.

The Malay characteristic of taking no thought for the morrow is recognized by the Government, which, to protect the native-born from the more acquisitive immigrant races, has arranged that in certain areas land tenancy is confined to the Malay population.

The Sakais, mentioned in the census figures, comprise the aboriginal races of the Malay Peninsula. The latter, of which several tribes are known, are a primitive people, living in the forests, subsisting largely on jungle products. They take little part in the economic development of the country.

The large Indian population includes a considerable number of Bengalis and Punjabis, but the bulk of those who cross the Bay of Bengal are Tamils from Southern India. The latter as labourers work for a lower rate of pay than Chinese coolies, and are more amenable to discipline.

The various races inhabitating the Federation co-operate together harmoniously. With the exception of the occasional faction fights among the Chinese, inter-racial disturbances are unknown.

BUCKET-DREDGING FOR TIN.

Description of a new method of saving the Cassiterite.

By W. W. RICHARDSON.

EXPERIENCE has developed the proportions of the mechanical parts of bucket-dredges, while the excavating depth and capacity have been increased considerably. The same progress is not to be seen in the concentrating part of the plant. The make-shift use of the sluice-box as a concentrator where large volumes of spoil are to be treated in a given time provides an apparatus exceedingly limited for recovering black tin. Sluice-box efficiency to yardage treated depends upon superficial area of the boxes, and the proportion of this is restricted, due to pontoon dimensions and by other reasonable economies.

If hydraulicking practice is followed for proportions of sluice-box area to the spoil to be treated, then a dredge excavating 150 cubic yards per hour would require 6000 superficial feet of boxes. One of the most recent dredges now being erected in Cornwall has been designed to obtain a large concentrating surface, yet it affords only 37% of the area necessary to enable an entirely efficient recovery.

A good recovery of black tin by dredging needs to be obtained by other methods than those at present in use. The sluice-box bottom is stationary, and the spoil that covers it is practically standing. There it remains dead to any really useful treatment until it is discharged as a concentrate.

A concentrating plant is being designed by me for another large dredge for operation in Cornwall. This plant embodies certain new arrangements which are expected to increase largely the recovery of fine black tin, without restricting the volume of spoil that it is desired to excavate.

In order to find the amount of material that could be cut out before reaching the sluice-boxes, the samples have been sized and the proportion of tin to these sizes ascertained. In this instance the ground sizes approximately as follows :

	%		Black Tin %
− 8-mesh	41	carrying	71
− $\frac{1}{4}$ in. diam.	17	carrying	13
− $\frac{3}{8}$ in. diam.	10	carrying	3
− $\frac{3}{4}$ in. diam.	12	carrying	9
+ $\frac{3}{4}$ in. diam.	20	carrying	?

The trommel is divided into three perforated sections, each section 8 ft. long, and drilled with holes of $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{3}{4}$ in. diameter, respectively. The trough under the trommel is arranged in tray form ; it returns the sized spoil to separate launders running athwartship, discharging upon endless-belt screens of 30-mesh ; the under-size is partly dewatered, and flows quietly through sluice-boxes of ample area, while the over-size is passed to an arrangement of hydraulic jigs, and the discharge from these goes to tailing.

The under-size of the third section of the screen ($\frac{3}{4}$ in. diam. holes) passes directly to a set of hydraulic jigs, which extract the tin-stone, and reject the waste to tailing. By this arrangement it is calculated to cut out from the sluice-boxes 61% of the total spoil raised. The sluice-boxes are to treat 39% of the spoil, which is sized through 30-mesh screens, and is dewatered to the proper proportion to allow a quiet flow through the boxes. These boxes are 4 ft. wide, by 50 ft. long. Five are placed longitudinally on each side of the trommel, and these give a superficial area of 66% of that usually allowed in hydraulicking practice. In this instance, the proportion of sluice-box area to spoil will be ample, as the conditions under which they are to work is one most favourable to concentration in boxes.

Patented mechanical rakes plough slowly through the top third of the spoil. These rakes have a reciprocating motion, the harrows being carried in a frame that runs on grooved wheels using the sides of the sluice-boxes as rails. The stroke is 20 inches forward, and only 19$\frac{7}{8}$ in. backward, and as there are two sets of frames working tandem, spaced 20 ft., it takes nearly two hours to work over 40 ft. of box.

Near the end of each sluice-box in a trap-door, and traversing these underneath is a launder connected to a chute leading to a bin in the pontoon. By this arrangement the concentrate from each box is quickly flushed through to the deck below. In this bin is a small bucket-elevator, which raises the concentrate, in order to pass it through the dressing-plant, which completes the winning of black tin, without handling by manual labour.

QUOTATIONS

of leading mining shares on the London Market.
Shares are £1 par value except where otherwise noted.
Quotations are given in shillings.

GOLD, SILVER, DIAMONDS:	Mar. 1 1913	Feb. 2 1914	Mar. 2 1914
RAND:			
Bantjes	23	16	15
Brakpan	86	60	53
Central Mining (£12)	205	175	162
Cinderella	17	7	6
City & Suburban (£4)	46	43	42
City Deep	65	66	62
Consolidated Gold Fields	59	54	47
Consolidated Langlaagte	29	34	31
Consolidated Main Reef	20	20	18
Crown Mines (10s.)	145	133	126
Durban Roodepoort	20	20	17
D. Roodepoort Deep	22	21	17
East Rand Proprietary	56	45	40
Ferreira Deep	66	50	47
Geduld	22	24	25
Geldenhuis Deep	25	27	25
Heriot	77	53	52
Jupiter	10	7	5
Kleinfontein	21	26	25
Knight Central	13	10	11
Knight's Deep	42	33	32
Langlaagte Estates	30	22	18
Luipaard's Vlei	10	10	10
Main Reef West	17	12	8
Meyer & Charlton	106	115	106
Modderfontein B	73	89	81
Modderfontein, New (£4)	245	256	240
Nourse	40	36	33
Primrose	35	36	27
Rand Mines (5s.)	135	130	116
Randfontein Central	26	27	21
Robinson (£5)	57	57	52
Robinson Deep	36	31	28
Rose Deep	61	50	42
Simmer & Jack	18	13	11
Simmer Deep	3	3	2
Springs	16	15	15
Van Ryn	76	72	68
Van Ryn Deep	25	41	42
Village Deep	42	40	33
Village Main Reef	46	42	33
Witwatersrand (Knight's)	62	76	68
Witwatersrand Deep	53	61	52
Wolhuter	18	15	13
RHODESIA:			
Cam & Motor	35	29	25
Chartered	24	22	19
Eileen Alannah	12	16	12
Eldorado	31	19	18
Enterprise	14	16	13
Falcon	24	17	16
Giant	17	18	17
Globe & Phœnix (5s.)	29	36	37
Lonely Reef	55	47	38
Shamva	58	46	42
Wanderer (5s.)	2	2	2
Willoughby's (10s.)	11	10	9
OTHERS IN SOUTH AFRICA:			
De Beers (£2 10s.)	430	385	375
Glynn's Lydenburg	23	16	15
Jagersfontein	150	112	105
Premier Diamond (2s. 6d.)	245	205	188
Sheba (5s.)	5	6	5
Transvaal Gold Mining Estates	56	51	42
WEST AFRICA:			
Abbontiakoon (10s.)	7	7	7
Abosso	18	17	16
Ashanti (4s.)	22	19	17
Broomassie (10s.)	7	5	5
Prestea Block A	16	15	13
Taquah	16	16	17
WEST AUSTRALIA:			
Associated Gold Mines	7	9	9
Associated Northern Blocks	17	9	7
Bullfinch	15	10	8
Golden Horse-Shoe (£5)	37	55	53
Great Boulder Proprietary (2s.)	12	15	14
Great Boulder Perseverance	2	2	3
Great Fingall	9	15	13
Ivanhoe (£5)	67	56	55
Kalgurli	45	38	37
Sons of Gwalia	20	23	24
Yuanmi	10	5	4

	Mar. 1 1913	Feb. 2 1914	Mar. 2 1914
OTHERS IN AUSTRALASIA:			
Blackwater	22	19	18
Consolidated Gold Fields of N.Z.	13	18	18
Mount Boppy	22	13	12
Mount Morgan	63	65	63
Progress	7	12	14
Talisman	40	42	42
Tasmania Gold (10s.)	1	½	½
Waihi	32	53	57
Waihi Grand Junction	21	27	26
AMERICA:			
Alaska Treadwell (£5)	172	160	165
Buena Tierra	20	16	15
Butters Salvador	51	35	30
Camp Bird	20	13	12
Casey Cobalt	56	40	31
Cobalt Town Site	73	55	50
El Oro	17	15	14
Esperanza	28	21	18
Granville	13	10	10
Mexico Mines of El Oro	132	102	107
Oroville Dredging	8	14	12
St. John del Rey	16	15	16
Santa Gertrudis	26	18	17
Stratton's Independence (2s. 6d.)	2	½	½
Tomboy	27	26	23
RUSSIA:			
Lena Goldfields	58	48	41
Orsk Priority	15	7	7
Siberian Proprietary	10	5	7
INDIA:			
Champion Reef (2s. 6d.)	11	10	10
Mysore (10s.)	110	98	105
Nundydroog (10s.)	26	26	27
Ooregum (10s.)	21	21	23
COPPER:			
Anaconda (£5)	147	156	147
Arizona (5s.)	40	40	40
Cape Copper (£2)	125	90	80
Chillagoe (10s.)	1	2	½
Cordoba (5s.)	7	6	6
Great Cobar (£5)	71	13	11
Great Fitzroy (5s.)	½	2	1
Hampden Cloncurry	44	35	32
Kyshtim	62	62	60
Messina (5s.)	20	30	33
Mount Elliott (£5)	150	82	76
Mount Lyell	24	25	25
Rio Tinto (£5)	1470	1470	1400
Sissert	25	30	31
South American Copper (2s.)	35	27	32
Spassky	81	61	62
Tanalyk	50	63	62
Tanganyika	48	45	42
Tharsis (£2)	140	135	137
Whim Well	22	8	8
LEAD-ZINC:			
BROKEN HILL:			
Amalgamated Zinc	34	30	28
British Broken Hill	42	44	42
Broken Hill Proprietary (8s.)	39	41	40
Broken Hill Block 10 (£10)	35	41	40
Broken Hill Block 14 (25s.)	9	8	7
Broken Hill North	45	56	57
Broken Hill South	153	172	172
Sulphide Corporation (15s.)	26	26	25
Zinc Corporation (10s.)	15	21	22
RUSSIA:			
Russo-Asiatic	—	107	140
Russian Mining	11	13	38
TIN:			
NIGERIA:			
Abu (5s.)	—	12	12
Bisichi	20	19	15
Jos (5s.)	8	8	8
Kaduna (5s.)	25	17	17
Naraguta	30	31	27
Nigerian Tin	26	18	17
N. Nigeria Bauchi (10s.)	4	5	5
Rayfield	20	11	9
Ropp	140	131	120
OTHER COUNTRIES:			
Aramayo Francke	31	35	36
Briseis	11	7	7
Cornwall Tailings	27	17	17
Dolcoath	20	17	14
Geevor (10s.)	17	7	7
Gopeng	31	28	28
Mawchi	26	27	25
Pahang Consolidated (5s.)	10	12	11
Renong Dredging	—	45	63
Rooiberg	33	28	26
Tekka	70	60	57
Tronoh	85	42	33

PRECIS OF TECHNOLOGY

Tin Assay.—At the February meeting of the Institution of Mining and Metallurgy, two papers were presented on the assay of tin ores. One was by H. W. Hutchin, of Camborne, describing his developments of what is usually known as the Beringer volumetric method, and the other by E. A. Wraight and P. Litherland Teed describing their investigations into the possible sources of error in connection with the Pearce method, or as it is sometimes called the Pearce-Low method.

These two methods were evolved with a view to determining more accurately the tin content of low-grade ore and tailing. Mr. Beringer described his process in this Magazine for November 1909. The object is to obtain the tin as stannous chloride in solution, as is also the case with the Pearce method. Mr. Beringer aims at producing metallic tin and dissolving it in hydrochloric acid. He mentions several reagents for doing this, coal-gas, magnesia, etc., but gives his preference to zinc vapour and zinc oxide. He mixes the ore with zinc oxide, magnesia, or lime before treating with the reducing agent, the object of the admixture being to prevent fritting or fusion during heating, and thus to produce a mass that breaks down completely when treated with hydrochloric acid. Mr. Hutchin, in an article published in this Magazine for April 1913, drew attention to the fact that if low-grade tin ores are heated with zinc oxide alone, they were more or less attacked and a proportion of the tin content rendered soluble in hydrochloric acid. In the paper read at the meeting of the Institution he shows that the function of the zinc oxide is based on a distinct chemical reaction hitherto unrecognized, namely, that zinc stannate is produced. On pursuing investigations, Mr. Hutchin found that lime, being a stronger base, is more complete in its action than zinc oxide. For instance, if 1 gramme of finely powdered cassiterite is mixed with 1½ grammes of calcium carbonate and ignited for ten minutes the whole of the tin is converted into calcium stannate, which is more readily soluble in warm hydrochloric acid than zinc stannate. The solution of calcium stannate in hydrochloric acid may be reduced by nickel. Mr. Hutchin in his paper describes in detail his many experiments, and the best way of carrying out the method in practice.

The Pearce method was introduced by Ernest V. Pearce at Williams, Harvey & Co's smelter at Hayle, and was communicated by Richard Pearce to A. H. Low, who incorporated a description of it in his book 'Technical Methods of Ore Analysis.' According to this method the ore is fused with caustic soda or potash or with sodium peroxide in an iron or nickel crucible, and the solidified melt dissolved in water to which an excess of hydrochloric acid is afterwards added. The object of Messrs. Wraight and Teed's investigations was to examine the various steps in the process and study the ranges of error and their causes. Briefly, the causes of irregularity in results were found in bad sampling, and in the errors due to the presence of arsenic, titanium, and wolfram. The information given relating to the errors caused by the presence of titanium minerals, more particularly ilmenite, constitutes the most important part of the paper. In all cases the results were too high, as proved by the tests of tin concentrate mixed with known portions of ilmenite and titanic acid. The tables of results given by the authors show the greatest error when the proportions of ilmenite or titanic acid were small. In the discussion on the paper, H. Livingstone Sulman stated his experience to be that the excess was more uniform, and that probably the variable excess noted by the authors was due to their working on samples that were too small. The authors have done a service in proving by experiment that the presence of titanium minerals makes the tin assay by the Pearce method too high.

Electro-Analysis.—We have in previous issues given précis of a number of articles describing various designs of cathodes intended to obtain the circulation required when using the strong currents necessary for making the operation economically rapid. Many chemists have adopted revolving cathodes of platinum or other metal. Others have recommended a cathode consisting of a fine gauze, and depending on the heat created by the current for the creation of a circulation of the solution. In *Metallurgical and Chemical Engineering* for February, D. F. Calhane and T. C. Wheaton describe their plan of using copper-coated brass gauze as a substitute for platinum gauze, as employed in the laboratory of the Worcester Polytechnic Institute, Massachusetts. The gauze is 100-mesh. Brass gauze can be made finer than copper gauze, and it is tougher and cheaper. The size of the pieces used is 5¼ by 3¼ in. The longer edges are turned over and hammered flat. The shorter edges are bent over copper wire to form a cylinder. After being cleansed of grease, the cylinder is given a coating of copper by insertion in a copper sulphate solution for a few minutes, using a current of 2 or 3 amperes. When dealing with ammoniacal solutions a platinum wire insert is used in the copper wire stem, which would otherwise be attacked by the ammonia fumes near the surface of the solution. As regards this form of cathode, it may be mentioned that the surface exposed is 50% greater than with a plane; but the larger area is not the only advantage, for it would appear that the form of the gauze has an effect in increasing the rapidity of the elimination of hydrogen. The authors give the results of many tests of the gauze in connection with determination of copper, nickel, and zinc.

Cementing Water-bearing Fissures.—In previous issues we have on several occasions described the methods of stopping the flow of water into mines by injecting cement. For instance, in March 1911 we quoted A. L. Shrager's account of the methods adopted at the Lens collieries; in October 1909 we gave the shaft-sinking practice at the Murton mine, Durham; and in November 1909 we described the method of stopping a water-flow at the Great Fingall mine, West Australia.

The January *Bulletin* of the American Institute of Mining Engineers contains a paper by Francis Donaldson giving his experience in connection with the sinking of shafts, in the course of the construction of the aqueduct for the New York water-supply. Good progress was made until a depth of about 100 ft. was reached. The first hole drilled in the bottom below this depth struck a stream of water; the flow amounted to about 150 gal. per minute. This was plugged. It was found that each of the 12 holes in the sump cut encountered the same stream of water. As soon as each hole cut the water-bearing seam, it was plugged with a tapered wooden plug. After all the holes in the sump had been drilled and plugged in this way, the grout connections were made one at a time, so as to restrict the flow of water into the shaft. Each connection was made with a piece of 2 or 2½ in. iron pipe about 3 ft. long, threaded at one end and given a long taper at the other. The tapered portion was made rough on the outside by nicking it with a chisel. A heavy iron stopcock was screwed to the pipe, the tapered end wrapped in several thicknesses of burlap, the wooden plug removed from the drill hole and the tapered pipe driven in, the stopcock being left open. This was the most exciting and the wettest part of the job. After the pipe had been driven in hard the stopcock was closed. Connections were placed in all the wet holes before grouting.

The grouting machine or tank used was the Caniff machine, in which the grout is mixed by air. It is built like an air lock with a door on the top through which cement, sand, and water are introduced, and has a 2-in. discharge opening in the bottom and air connections top and bottom. The discharge opening is connected to the grout hole by a heavy rubber hose. Another 2-in. stopcock is placed at the outlet of the tank and a 2 by 1-in. tee is placed between the hose and the cock attached to the pipe in the drill hole. Into the side opening of this tee a 1-in. stopcock is screwed. The machine is installed at the bottom of the shaft, and is connected to one of the holes and also to the high-pressure air supply. The 2 in. stopcock on the machine is closed and the other is opened. The door in the top is opened, a sack of cement, three or four buckets of water, and (if the cavity to be filled is large) a sack of fine sand are poured in, the air connection at the bottom is opened and the air allowed to bubble through and mix the grout. Then the door is closed quickly, the lower air connection is closed, and the discharge connection and the upper air connection are opened, and the air enters and drives the grout into the cavity. A man stationed at the 1-in. stopcock keeps opening it slightly ; when air shows instead of grout he closes the 2 in. stopcock and the machine is re-charged. If the cavity is open it takes 3 or 4 seconds to push in the charge. By working continuously more than 1000 batches can be placed in 24 hr.

The grouting of the fissure was successful and sinking was resumed. About 50 ft. farther down another water-bearing fissure was encountered, and this, instead of being open, was filled with sand formed by the crushing of metamorphic gneiss due to folding ; this sand was carried up out of the drilled holes in large quantities by the water. Grout will not permeate sand and it was necessary to continue drilling holes and pumping in grout, increasing the pressure at the end from 100 to 400 and 500 lb. per sq. in. The sand was tamped so full of cement that when cut through it was compacted like sandstone and contained balls of grout from the size of a fist to as large as a man's head.

The most difficult grouting on the aqueduct was done on the Hudson siphon, which is a deep siphon tunnel under the Hudson river at a depth of 1100 ft. below tidewater. The shafts were sunk by the city engineers, after which the contract for the driving and lining of the tunnel and lining the shafts was let. About 150 ft. from the foot of the east shaft the heading cut a water-bearing fissure which discharged about 300 gal. per minute. The full flow did not develop until the cut was blasted. The problem then was to grout this flow against a hydrostatic pressure of 500 lb. per square inch, with no solid rock to which to make grout-pipe connections. This problem was finally solved by the construction of a concrete bulkhead 8 ft. thick across the full section of the heading. The concrete was mixed in proportions of 1:2:4 and was heavily reinforced with rails set into holes drilled laterally into the sides, roof, and floor of the tunnel. Grout pipes leading into the fissure were set through the bulkhead. After the concrete had set for a week, grout was forced into the fissure, first by the pneumatic process with a high-pressure air compressor and finally by means of a high-pressure plunger pump, which forced water instead of air into the grout tank. Pressures were reached in this way up to 1000 lb. per square inch.

In driving or sinking through rock containing a large number of seams carrying small quantities of water, it is not practicable to stop and grout each seam as described above. In this case it is advisable to increase the section of tunnel or shaft sufficiently to allow for a heavy concrete lining. Drains should be provided opposite all of the water-bearing fissures to carry off the water while the lining is being placed. After the concrete has secured sufficient strength, the drains may be grouted. By a combination of these two methods it should be possible to penetrate any firm rock, no matter how much water it contains.

Leaching Copper Ores.—In the *Mining and Scientific Press* for January 24, H. W. Morse describes the process invented by H. B. Slater, of Riverside, California, for leaching sulphide ores of copper by hypochlorous acid, H Cl O. A solution of this acid is produced in an electrolytic cell where common salt is electrolysed in presence of ferric oxide. The liberated chlorine attacks the ferric oxide with the formation of ferric chloride and hypochlorous acid. The solution containing salt and the two latter products is used for leaching the copper ore. For an ore containing 2 to 2·5% copper, the solution will contain 5 to 7 grammes per litre of iron as ferric chloride, and a corresponding amount of hypochlorous acid. In the cathode compartment sodium hydroxide is formed, and this is used at a later stage of the process. If chalcocite is the chief copper mineral present, the leaching reaction, as far as the hypochlorous acid is concerned, is : $Cu_2S + 4HClO = 2\ CuCl_2 + 2\ H_2O + SO_2$ (or, $S + O_2$). The alternative $S + O_2$ is given, as a part of the sulphur is freed in elemental form. The SO_2 produced in this reaction reduces part of the cupric chloride to cuprous chloride :

$$2\ CuCl_2 + 2\ H_2O + SO_2 = 2\ CuCl + 2\ HCl + H_2SO_4$$

so that even at this point in the process a considerable portion of the extracted copper is present as cuprous chloride, held in solution in the sodium chloride solution. At this point the leaching liquor contains ferric chloride, ferrous chloride, cupric chloride, and cuprous chloride, all in salt solution. To it there is added sufficient of the sodium hydroxide solution, from the cathode compartment of the cell, to completely precipitate all of the iron as hydroxide, according to the reaction :

$$FeCl_3 + 3\ NaOH = Fe(OH)_3 + 3\ NaCl$$

$$FeCl_2 + CuCl_2 + 3\ NaOH = Fe(OH)_3 + CuCl + 3\ NaCl$$

This last reaction is an interesting one chemically, especially because cupric chloride acts here as an oxidizing agent, raising ferrous to ferric iron. This reversal of the usual order of things takes place because of the complete and immediate removal of the ferric iron as hydroxide as fast as oxidation takes place. A slight excess of the sodium hydroxide causes no precipitation of copper as hydroxide, for the copper is all locked up in the complex form with the sodium chloride, and the concentration of ferrous iron is so slight that a considerable excess of hydroxide is required to produce a precipitate. The combined reduction effect of the ferrous chloride at this stage and the sulphur dioxide in the previous one results in the complete reduction of all the copper to the cuprous form. This is of practical importance, as it is only necessary to supply a single equivalent of chlorine for each copper molecule instead of two equivalents, which would be needed if the copper were to be extracted as cupric chloride. In practice it is only necessary to supply a very slight excess of chlorine in the leach over that calculated for the cuprous chloride equivalent.

The copper can be recovered by the usual methods, or it can be precipitated with the aid of the sodium hydroxide as cuprous hydroxide. If this precipitation is made with hot sodium hydroxide solution, air oxidation is rapid and the ordinary black oxide of copper is formed. Probably the reaction:

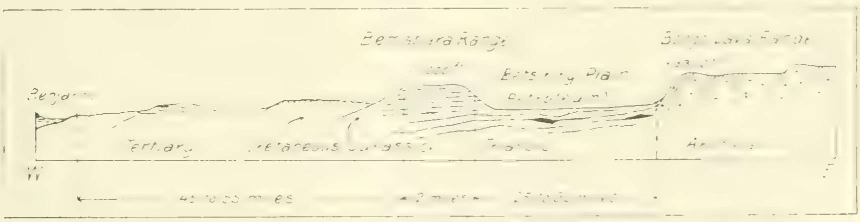
$$2\,CuOH + O = 2\,CuO + H_2O$$

will express this step. The black oxide so formed might well be cast into blocks and used as cathodes in the electrolytic cell giving metallic copper, and resulting in a noticeable decrease in the working voltage of the cell.

It is evident that the process is completely cyclic chemically. No chemicals are brought in from outside except the salt, which may be lost in the final wash waters, and this can be reduced to as low a point as may be desirable in practical operation

The only reason for roasting any part of the ore treated would be to bring up the iron content of the leach in order to produce sufficient ferric hydroxide to restore the original concentration for the next leach. This might be necessary in the case of an ore containing much lime. If the ore is not roasted, practically none of its iron is leached out with the copper.

Petroleum in Madagascar.—We have on previous occasions referred briefly to the occurrence of petroleum in Madagascar, notably in our issues of December 1911 and November 1912. The *South African Mining Journal* for January 24 gives a translation of part of David Levat's report on the mineral resources of the island, prepared for the French Colonial Minister and the Governor of Madagascar. At the present time several South African syndicates are interested in these oilfields. A cross-section herewith gives a general idea of the structure across the western portion of the central part of the island, from the Bongo-Lava highlands to the sea. This range of highlands rises to 3300 ft., and is composed of a series of Archean rocks, which mark an important line of fracture running along practically the whole of the western side of Madagascar. A similar line of fracture runs along the eastern coast, and has contributed largely to the shaping of its outline. A difference between the two lines is that the one on the west is sinuous while that on the east is notably straight. To the west of the foot of the Bongo-Lava range is the sandy marshy plain of Betsiriry, on the other side of which is a lower range of hills, called the Bemahara. Lying on the Archean rocks of the Bongo-Lava are the Triassic sandstones of Betsiriry, in which the petroleum seepages and bituminous occurrences are found. Above the sandstones come calcareous rocks of the Jurassic system, followed by Cretaceous and Tertiary rocks allied to those which cover such large areas on the eastern side of the South African continent. Mr Levat reports that petroliferous indications of varying importance are found along the narrow belt of Triassic rocks that runs in a continuous line for over 300 miles along the western side of the island.



VERTICAL SECTION ACROSS MADAGASCAR OILFIELDS.

Tin Dredge for Siam.—*The Engineer* for February 13 contains an article, accompanied with many photos and line drawings, of the new dredge designed by Cutten Brothers and built by Lobnitz & Co., of Renfrew, Scotland, for the Siamese Tin Syndicate. This syndicate was formed in 1906 to acquire concessions at Ngow near Renong in the Western Siamese States, not far from the property worked by the Renong Tin Dredging Co. A dredge having buckets of 7 cu. ft. capacity was started in 1912, and results were so satisfactory that two additional dredges of much greater capacity were ordered. These were shipped in July and August last. The dimensions of these two dredges are not precisely identical, but the description of one will serve for both. Probably these are the largest dredges for saving ore or metal ever built in England. The pontoon is 140 ft. long, 46 ft. wide, and 10 ft. 3 in. deep. The bucket has a capacity of 15 cu. ft., and weighs 30 cwt. without links or pins. The rate of travel is such that from 12 to 15 buckets are discharged per minute. The tumblers are made of manganese steel; the top one is a complete casting, fitted to a 20-in. shaft, which is reduced to 14 in. at the journals, and the bottom is in two parts, weighing together over 6 tons. The complete ladder with rollers, bottom tumblers, and bucket chain weighs 160 tons. The total weight of the dredge is 870 tons. Three derrick cranes are fitted to the forward gantry, one each side, for handling the tumblers or other heavy weights from the shore to the dredge, and one in the centre for lifting the buckets, links, or ladder rollers into position. The spur wheel on the tumbler shaft is 11 ft. diam., 13 in. wide, and 4½ in. pitch of teeth. The intermediate gear is 8 ft. diam. and 3½ in. pitch, carried on a shaft 8½ in diam. The power is supplied by two 200 h.p. gas engines using gas obtained from charcoal and a smaller one of 12 h.p. One of the larger engines drives the buckets, the trommel, and the tailing elevator, and the other the centrifugal pumps, winches, silt wheel, and distributor. The small engine supplies electric lights, drives lathes, etc., and compresses air for starting the main engines. The trommel is 35 ft. long by 7 ft diam., and weighs 20 tons. The tailing elevator is 65 ft. long, and the silt-wheel 20 ft. diam. The tin-saving tables cover an area of 2700 sq. ft., and the boxes into which they are divided are 4 ft. wide and 68 ft. long. The tin-bearing sand passing through the trommel is distributed to the tables by a revolving mechanical distributor, of special design. The maximum accumulation of concentrate allowed is 150 tons, and compensating water-ballast tanks are provided to keep the pontoon in trim. The article contains a large amount of information relating to the gas-engines. Mr. Cutten favours this type of power generator which, in his experience, gives good results.

Geology of Katanga.—The Transactions of the Geological Society of South Africa for 1913 contains an elaborate article by F. E. Studt on the geology of Katanga and Northern Rhodesia, being an elaboration, based on further knowledge acquired, of a paper read before the same society in 1909. Mr. Studt divides the region into six sections and considers them separately: Southern, Northwestern, and Northeastern Rhodesia, Southeastern and Northwestern Katanga, and the Lower Congo Basin. We give herewith a short abstract of the author's main points relating to Southeastern Katanga. The accompanying table indicates the nature of the rocks and their analogues in the Transvaal. The Katanga district is situated to the north of the main divide between the Congo and the Zambesi, and is from 4500 to 6000 ft. above the sea-level. In the southeastern part the rocks are all Archean, corresponding to the Swaziland, Transvaal, and Waterberg Systems of the Transvaal and Orange which are usually more or less pyritic. The dolomites are often oolitic and have a frequent development of chert bands. The grey colour is due to finely distributed carbon, which is sometimes sufficiently plentiful to produce a black colour. Near the granite the dolomite is crystalline and colourless. Many interbedded hematite and limonite deposits are found, and in some places these minerals also occur as large irregular masses. The copper deposits are usually associated with cellular quartzose rock that has resulted from the solution of the dolomitic constituents of a dolomitic silicious breccia. This breccia traverses the rocks parallel to their cleavage, and not to the original bedding, so that the silicification and dolomitization were the result of the earth movements and mineralization connected with the formation of the copper deposits. The ore-shoots are generally coincident with or parallel to these cellular quartz runs, and cross the original bedding at high angles.

		Transvaal and Orange Free State	Southeastern Katanga
Permo-Carboniferous	Lower Karroo System ...	Ecca Dwyka Conglomerate	
	Waterberg System.........	Waterberg Beds and Volcanics	Lubilash Beds
Archean	Transvaal System	Pretoria series Dolomite series Black Reef series	Watershed Granite Kundelungu Beds Lufira Beds Kambove Beds Wemashi Beds
	Ventersdorp System	Ventersdorp series	
	Witwatersrand System..	Witwatersrand Beds	
	Swaziland System	Swazi Granites Swazi Schists	Kafubu Quartzites

Free State. In Northwestern Katanga the Lower Karroo beds, corresponding to the Dwyka conglomerate and Ecca beds, and classed as Permo-Carboniferous, are found. There are no rocks corresponding to the Ventersdorp and Witwatersrand Systems. Southeastern Katanga contains the copper belt, and the Northwestern the tin belt. The Kafubu beds of Southeastern Katanga, belonging to the Swaziland System, consist chiefly of compact granular quartzites, generally white to pale red, in places passing into quartz and mica schists, especially in the vicinity of granite intrusions. The Wemashi beds, of the Transvaal System, occur in narrow zones at many places, and consist of a great variety of conglomerates, greywackes, and shales. The Kambove beds, together with the Wemashi beds, form practically the whole of the country between the watershed and the high plateau in the Southeast Katanga district. The true inclination of these beds is seldom great, but the bedding has generally been obliterated, and a well developed cleavage at steep angles is apt to give the false impression that the rocks are much folded and steeply inclined. The copper deposits and the gold and platinum deposits at Ruwe occur in the Kambove beds. The beds consist of an alternating series of dark to light-grey dolomites, sandstones, and shales,

Mr. Studt discusses the copper deposits in conjunction with those in Northwestern Rhodesia, at Bwana M'Kubwa and Kansanshi. The Katanga copper belt is 250 miles in length, and from 30 to 60 miles in width, following the general strike of the rocks. Broad bands of crush breccia and fault conglomerates are common in the copper areas. The length of the cupriferous zone is generally along the strike, but in a few cases cuts across it. In depth, the deposits follow the cleavage of the rocks, which may cut across the original bedding at a considerable angle. At Kansanshi, where the rocks are uncleaved and lie nearly horizontal, the strata have been arched into a dome-like hill, from which the rocks dip on every side, and have been opened perpendicularly to the strata in long parallel fissures in which the copper ores occur. These fissures, which are numerous near the surface, are wedge-like, and generally decrease in width with depth. The larger fissures, however, generally preserve their widths in the upper silicious rocks, but most of them lose their special characteristics, and split up into small stringers on penetrating some distance into the crystalline dolomite which has chalcopyrite grains disseminated through it.

In the Bwana M'Kubwa deposit, the strata are apparently vertical with an interbedded lode, having well-defined walls, and only differing from the Kansanshi fissures in that it is apparently parallel to the strata, instead of being perpendicular to them. On further investigation below ground, however, the walls of the lode change from hard quartzitic rocks at the surface, to softer argillaceous rocks below, and finally to dolomites. In the softer intermediate rocks there is frequent evidence of crumpled and contorted bedding planes abutting on the smooth and straight cleavage planes of the rocks, which they cut at large angles. The dolomites, which are entered at about 350 feet below the surface, do not outcrop in the immediate vicinity of the mine, as they should do if the bedding were steep, but are found some distance away, showing only slight inclinations over large areas of country. Here again the lode seems to lose its special characteristics on passing into the dolomites. Thus it is seen that Bwana M'Kubwa, although apparently a different type of deposit to the Kansanshi, is in reality an almost exactly similar type, only differing in the development of cleavage in the rocks.

The Star of the Congo mine in Southeastern Katanga, has also generally steep cleavages, which sometimes cross the bedding-planes at high angles. This bedding also in places shows considerable contortions, abutting against clean, straight cleavage planes, producing a variegated marbled effect on them by diverse colouring and the nature of the original bedding bands. Here again the ore zone in depth is parallel to the cleavage, and not to the bedding planes, and also there are solid dolomites, having disseminated pyrite in depth, giving place to superficial oxidized ore deposits near the surface.

The Bwana M'Kubwa and Star of the Congo deposits are similar in type to the majority of the deposits along the copper belt. These deposits are generally lenticular in plan, the cupriferous rocks gradually merging into the barren ones at the surface. In the southeastern end of the belt, they frequently occur in close proximity to the intrusive watershed granite, which is probably of lower Devonian age. The folding of the Transvaal rocks of Katanga is probably connected with this granitic intrusion, and the formation of the copper deposits was probably an accompaniment of these disturbances, the fracturing of the rocks giving vent to the mineralizing vapours or solutions, which were the source of the mineral deposits.

From what work has been done on these deposits in depth, it seems probable that the surface ores are the result of oxidation from pyritic veins, and in a few cases such pyritic veins are found at the surface, although these are probably of secondary origin.

Rhodesian Gold Production. — The *Rhodesian Mining Review* for February 4 gives a lengthy report on the gold-mining results during 1913. The total output of gold was valued at £2,903,268, as compared with £2,707,369 in 1912. The output according to districts was as follows :

	1912 £	1913 £
Bulawayo	650,832	780,928
Gwelo	831,309	901,578
Hartley	637,391	638,794
Lomagundi	238,630	200,876
Mazoe	123,021	134,603
Salisbury	32,663	29,937
Umtali	195,707	198,989
Victoria	542	14,837

The decrease in the Lomagundi figures is due almost entirely to a fall in the output at the Eldorado. The Mazoe district has suffered by the closing of the Hay mine, and by the fall in the Jumbo output, but on the other hand, the Kimberley has been an important accession to the list of producers, having yielded £29,660 during the seven months of productivity. Within a short time the Mazoe output will be reinforced by the Shamva. In the Lomagundi district, the Golden Kopje will soon be adding to the returns, and in the Salisbury area, the Planet-Arcturus group are coming producers. The Falcon, as a copper-gold property, will add to the output. The Cam & Motor will greatly add to the production in the Hartley district during 1914.

The following table gives a list of the principal producers and the value of their output :

Bulawayo District :	1912 £	1913 £
Antelope	—	4,612
Bushtick	37,878	57,797
"C"	21,066	16,471
Claremont	35,865	8,566
Matabele 3	20,195	33,469
Eagle A	9,826	13,333
Farvic	7,405	11,268
Fred	8,646	32,950
Lonely	158,841	219,134
Matabele Queen's	37,769	47,292
Nelly	5,196	23,148
New Eclipse	14,465	10,660
Old Nic	35,547	43,749
Susanna	26,886	22,855
Tuff Nut	22,096	12,180
Gwelo District :		
Csardas	22,580	28,865
Gaika	61,941	66,297
Globe and Phœnix	476,584	516,116
Gothic	—	9,056
North Bonsor	16,068	25,212
Wanderer	86,977	73,862
Hartley District :		
Acorn	3,635	8,614
Agnes	—	8,152
Battlefields	30,242	20,726
Brilliant	21,629	25,222
Cam and Motor	1,583	5,372
Cheshire Cat	910	12,407
Concession Hill	29,739	28,342
Eiffel Blue	32,492	32,527
Giant	205,257	139,476
Glasgow	5,583	10,893
Glencairn	17,222	13,083
Golden Valley	11,190	17,247
Kanyemba	19,798	16,324
Masterpiece	10,942	—
Owl	32,463	31,894
Pickstone	31,422	41,030
Seigneury	4,150	9,042
Shepherds	27,794	21,571
Sid	11,680	15,504
Tea	4,353	9,061
Thistle-Etna	12,111	58,131
Washington	18,009	15,274
Lomagundi District :		
Eldorado	225,408	185,234
Linnett	5,428	7,427
Mazoe District :		
Hay	27,873	—
Jumbo	59,604	54,441
Kimberley	—	29,660
New Found Out	—	7,655
Thornhill	8,407	12,861
Salisbury District :		
Louise Grand	1,836	7,329
Mont d'Or	5,946	4,993
Old Loyalty	11,042	3,728
Umtali District :		
Champion	330	7,051
Elgin	3,286	8,899
Kent	4,570	10,462
King's Daughter	2,119	7,193
Pilgrim	4,441	9,000
Quagga	—	6,605
Rezende-Penhalonga	55,570	131,979
Rezende D.B.	7,253	8,635
,, I. W.A.	14,835	13,229
Victoria District :		
Texas	—	12,606

Hammer Drills.—At the meeting of the New York section of the Mining and Metallurgical Society of America, held on December 18, the subject for discussion was the hammer drill and its superiority over the old piston drill. The discussion was opened by the users of the hammer drill, who gave their experience. Afterward, W. L. Saunders, of the Ingersoll-Rand company, made a valuable contribution to the discussion. Our readers are probably aware that the Ingersoll-Rand company has recently made the Leyner hammer drill their chief specialty. We quote Mr. Saunders' remarks at some length, as we consider the subject to be of timely interest.

All the early types of rock-drills were piston drills; that is, the steel carrying the bit was rigidly clamped to the piston, the bit being practically an extension of the piston rod. This type of drill had many advantages. It was simple in construction. The only quick-moving parts were the piston and the valve, and the churning action of the bit helped to clear the cuttings from the hole. In the course of time, mining men sought to introduce rock-drills into all parts of the mine. The first tendency was to increase air-pressure. It was found that a rock-drill would do from 25 to 35% more work when running at 80 to 100 lb.; and as these increased pressures were applied, the machines themselves had to be made stronger and heavier, the mountings were made larger, the repairs became greater. This condition led to an increase in the weight of the drill until it ran up to 300 or 400 lb., except when used for soft rocks, where lighter piston drills were used efficiently even at lower air pressures. About 15 years ago engineers began to design a different type of rock-drill, now known as the hammer drill. In a hammer drill the piston and the steel carrying the bit are separated, the bit being pressed upon the rock and the piston hitting it on the end in the way a hammer drives a nail. To do work with such a machine it was necessary to have some means of clearing the cuttings from underneath the bit. As there was no churning action, the bit being merely rotated, it became necessary to blow these cuttings away; this was done at first by water, and later by a combination of air and water, which was forced through a hole in the centre of the steel. This type of drill, using air and water for discharging the cuttings, was patented and introduced by J. G. Leyner, of Colorado. Mr. Leyner demonstrated that in actual speed of drilling, especially in holes that were at or near the horizontal, this drill would increase the speed of drilling from 50 to 100%. He also demonstrated that, with the hammer drill, high air-pressures might readily be used without undue damage to the machine or the mountings. It is evident that, when using air at, say, 100 lb. pressure in a hammer drill, in which a piston weighing only 8 lb. is reciprocated, say, 1000 times a minute, the jarring effect is considerably less than when air at the same pressure is used to pulsate a heavy piston carrying a steel, the whole weighing 50 to 75 lb. The momentum of the moving parts in the latter drill was such that heavy cushions were required in the cylinder ends, thus causing oscillation, which acted upon the mountings in such a way as to make it difficult to hold the drill steadily during hard service. Mr. Leyner's success in demonstrating the essential features of the hammer drill led to the rapid introduction of the stoper, which is a hammer drill without the air and water features, and without any mounting other than an air piston upon the tail end of the machine, for pressing it forward against the rock. The stoper is essentially a drill for up-hole work, where the cuttings fall out of their own weight, but the stoper illustrates in a practical way the essential features of the hammer drill in that it gives an efficient machine of large capacity and of light weight and great simplicity.

The modern type of hammer drill, which has been so largely introduced during the past two years and is known as the Leyner-Ingersoll, is a stoper that has been designed and built for all classes of work in mines, and is not limited to up-holes only. In making it suitable for universal service it became necessary first to introduce air and water into the hole to discharge the cuttings, and next to provide a system of automatic rotation of the bit. It further became necessary to employ steel and alloys of steel, treated by special processes of annealing. Such a machine weighs from 45 to 150 lb. It contains no heavy moving part; hence it is easy to mount. The smaller machine, known as the 'jackhamer,' requires no mounting at all, being simply held in the hand of the operator. It is usually used for down-holes where the weight aids in steadying the machine. Where the 'jackhamer' is used for inclined or horizontal holes, it is made so light in weight as to be easily handled, and it weighs from 20 to 32 lb. only. The sinker, so called because it is a 'jackhamer' for shaft-sinking, and foot-wall or bench work in mines, is used only for down-holes. Its weight is about 90 lb., and while it might be made lighter it has been found advantageous to add to the weight so as to hold the machine more steadily down to its work. For driving, side stoping, and all classes of heavier work in mines, the Leyner-Ingersoll drill does not exceed 150 lb. in weight. These machines are not provided with the usual chuck, comprising bolts and nuts, and requiring constant attention. On the contrary, the steel is held loosely in the front head bushing, in the way a man would hold a piece of steel in his left hand, the piston or hammer striking the top of the steel as he would strike with a hammer in his right hand while holding the steel in his left. The operator does not find it necessary to have a helper to break away a ragged edge of the rock so as to enable him to start a hole properly. With a piston drill, on attempting to start a hole on an inclined or irregular surface, unless a hammer and chisel are used to break away a level place for it, more time will be consumed in starting than in drilling with the first length of steel. With the hammer drill, the bit is simply pressed upon the surface of the rock, automatically rotated, while being struck on the end, and the hole is quickly started.

This one-man drill is not an adaptation of the old type of machine, but a new design, based on different principles, weighing less than half as much, maintaining itself more easily in position, feeding its air and water through the steel automatically, and doing away with the helper. That the hammer drill has won its way on merit is amply demonstrated by the records that it has made during the last two or three years in different parts of the United States. In the Lake Superior copper country, for instance, several hundred of these drills have been used over a period of more than a year. The results invariably show a higher drilling efficiency, a higher tonnage efficiency, and an increase in the workman's wages. The net increase in drilling efficiency, based on feet of hole drilled per shift, when comparing the piston with the Leyner type in the Lake Superior district is 90%, and the net tonnage increase per shift is about 33%.

Other engineers joining in the discussion pointed out that the hollow drills are apt to break or become hot in an unaccountable way. It was suggested that the vibrations in the drills did not synchronize with the blows and that breakages would therefore be caused. Another view was that the method of manufacture of the hollow drills accounted for the breakages. Mr. Saunders stated that the method of choosing a steel and making the hollow drills was certainly a source of trouble, and the steel that gave the best results was being imported from England.

Stope-filling on the Rand.—In our issue of December last we gave an abstract of a paper read by W. A. Caldecott and O. P. Powell before the Chemical, Metallurgical, and Mining Society of South Africa, describing the stope-filling system at the Simmer & Jack. The December issue of the journal of the society contains a contribution to the discussion of the paper by R. E. Sawyer, describing the system

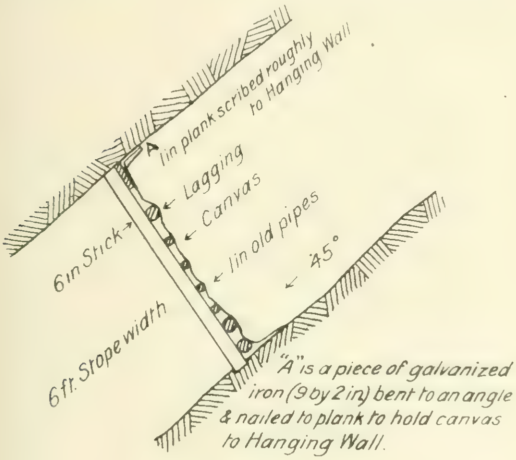


FIG. 1

adopted at the Angelo section of the East Rand Proprietary. At the Angelo, the stope-filling, though designed primarily for the purpose of the prevention of caving, is used at present chiefly for reclaiming. The sand used comes from two plants, that from one of them being lowered through an old shaft, and that from the other through a 300-ft. bore-hole 8 in. diameter, into the upper levels. From here it is run through the old and partly caved workings, through launders and on the foot-wall, down to the 18th level, which is at a depth of 2630 ft. vertically. The distributing launders are laid wherever possible at an inclination of about 15°, and never less than 12°. They are made of two planks, 9 by $1\frac{1}{2}$ in., nailed together in the form of a V. It has been found that the sand flows better in a launder of this shape than in one of rectangular cross-section with a flat bottom. Moreover the wear is inappreciable, except at curves or sudden drops, and at these points old belting is used as a liner. When filling stopes for the general purposes of supporting the roof, jute matting is used for barriers instead of coconut matting, as it is much cheaper, except in places where a large amount of water has to be drained rapidly through a small area. The jute is laid on lagging poles 3 to 4 in. in diameter and old pipes of 1 in diameter, which are nailed to light upright poles. These poles need not be heavy, from 6 to 8 in. diameter to 8 ft. length being sufficient, as the lateral pressure is not great. The general arrangement is shown in Fig. 1 accompanying. With the high-class sand produced by the Caldecott classifier, these barriers drain efficiently without any other device such as drainage launders being required. A rise can be put through this sand on the hanging wall within two days of filling. The cost per ton of sand placed in position was 5·2d. during October 1913, the total cost being £423 for 19,490 tons.

Mr. Sawyer gives illustrations of the methods of reclaiming pillars. Fig. 2 shows the case of a row of pillars above and below a drift, with a patch of banket left on the hanging wall in a very wide stope. The bottom box-holes of the stope are closed and sand is run in until a cone is formed, having its apex just below the level. The box-hole immediately above is then

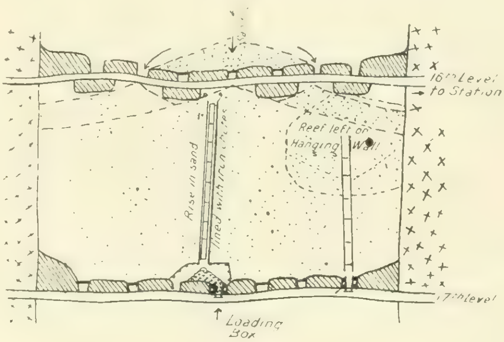


FIG. 2

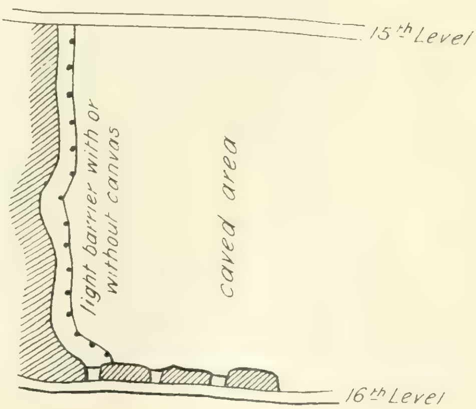


FIG. 3

closed, and the sand is run down through the box-holes on each side. This process is continued until there are a series of cones below box-holes, and all the box-holes above are closed, and the stope above filled with sand. The rock reclaimed may be either trammed out on a track laid on the sand, or shot down a rise through the sand to the level below. The floor of the rise is lined with iron chutes hung from the top. The banket left on the hanging wall is reached by rising to it and undercutting in the sand sufficiently for the banket to be blasted as required. No timber is used in the rise. Light timber is used to keep the sand off the track as the pillars are taken out.

Fig 3. illustrates the case of a stope that shows signs of caving and has become too dangerous to work. The stope is swept down and a light line of poles and lagging is run within 4ft. of the face. The box-holes are then closed and the sand run in. When the stope is full, the sand between the face and the timber is dug out from below and stoping resumed. When possible, jute matting is laid on the timber and the stope face kept free from sand, but sometimes owing to bad hanging and foot wall this is not possible.

Diamonds in the Rand Banket.—At the meeting of the Geological Society of South Africa held in March a year ago, R. B. Young gave an account of the discovery of a diamond in the banket at Modderfontein B. A note of this paper was given in our columns and elsewhere at the time, but as Mr. Young's full paper has now been published, we quote from it at length, as the subject matter bears to some extent upon the question of the origin of the banket. This is the third diamond recorded to have been found in the Main Reef Series, though in the Elsburg Series at Klerksdorp a sufficient number were found to warrant the use of the word 'diamond' in the name of the Klerksdorp Gold & Diamond Company, which was formed to work one of the properties. According to John Ballot, who read a paper before the Society in 1896, two diamonds were found in 1889, one at the Wolhuter and the other at the Percy, which is now merged in the Treasury. Both were found in the mortar-boxes. That found at the Percy was described by Mr. Ballot as being of a light bottle-green colour. No information is extant as to the nature of the diamond found at the Wolhuter, though its existence is also mentioned by Moreau in a book published in Paris in 1906. At Klerksdorp the stones were of varying shades of green; they were almost always found in the mortar-boxes; and averaged 1 to 2 carats in weight, though one as large as 8 carats is recorded by G. A. Denny in his book 'The Klerksdorp Gold Fields.' Mr. Denny states that their form was frequently the rhombic dodecahedron.

The stone recently discovered at Modderfontein B was found in the black sands from the mortar-boxes by A. C. Lurie, a student at the South African School of Mines. It weighs about $\frac{3}{4}$ carat, and is of a light greyish olive-green colour. It is in the form of the hexoctahedron, and has curved and slightly worn faces. It is noteworthy that all the diamonds of which records have been kept have been of a green colour. It may be considered as certain that the diamonds in the banket were deposited with the pebbles during sedimentation, and the occurrence is interesting as proving that there exists a source of diamonds in the pre-Witwatersrand rocks from which the banket was derived. Mr. Young draws attention once more to the desirability of examining the black sand more closely than is usually done. Already diamonds, iridosmine, and gold telluride have been found in them.

CURRENT LITERATURE.

Air-lift Pumps.—In the *Mining and Scientific Press* for January 17, A. E. Chodzko discusses the air-lift as applicable for pumping water from mines.

Monazite.—The *Journal* of the Society of Chemical Industry for January 31 contains a paper by S. J. Johnstone, giving the analyses of samples of monazite from a great many districts throughout the world.

Alaska Juneau.—In the *Engineering and Mining Journal* for February 7, Robert A. Kinzie describes the plans for developing the Alaska Juneau gold properties opposite Treadwell, Alaska.

Gold-Mining in Japan.—In the *Engineering and Mining Journal* for January 17 and 24, T. M. Yoshida describes the Yamagano gold mine at Satsuma, Japan. This mine has been worked for over 250 years and has recently been equipped with modern stamps and cyanide plant.

Mining Methods at Bingham, Utah.—In the *Engineering and Mining Journal* for February 21, D. W. Jessup commences a series of articles describing the top-slicing methods adopted at the mines in Bingham, Utah, where wide irregular sulphide orebodies are found in the limestone.

Northern Territory of Australia.—The *Mining and Engineering Review* for January 5, contains an account by H. I. Jensen, government geologist, of the present state of mining in the Northern Territory of Australia.

Gold Dredges.—In the *Engineering and Mining Journal* for February 7, George E. Sibbett, mechanical engineer to the Yuba Consolidated, discusses the design of buckets used on gold dredges.

Thawing Frozen Ground.—In the *Mining and Scientific Press* for January 14, Arthur Gibson describes the methods of thawing frozen ground in placer mining, and gives experience as to the cost and efficiency of some work done at Cape Nome, Alaska.

Chloridizing Sulphide Ores.—In *Metallurgical and Chemical Engineering* for February, John L. Malm gives his latest practice in the process for forming chlorides of metals from sulphides in the dry state by acting on the complex ore with gaseous chlorine and recovering the metals from the solutions formed by dissolving the reaction products in water. We referred to this process in our issues of December 1909 and February 1910. The process is not yet working on a commercial scale.

Molybdenum in Gold Ores.—In the *Engineering and Mining Journal* for February 14, J. E. Clennell describes his investigations in connection with the gold ore at Butters Salvador mines, and his identification of the disturbing element as molybdenum.

Slag Calculation.—In the *Engineering and Mining Journal* for February 7, Donald M. Liddell presents a graphic method of calculating blast-furnace slags.

Metallurgy at Nipissing.—The January *Bulletin* of the American Institute of Mining Engineers contains a lengthy paper by James Johnston on the metallurgical practice at Nipissing. We have already described the practice in our issues of June 1912, June 1913, and October 1913.

Stratification in Mineral Deposits.—At the February meeting of the Institution of Mining and Metallurgy, W. P. Dreaper presented a paper describing experiments which showed that precipitation and stratification can be obtained by the interaction of two solutions in the absence of gels.

Secondary Enrichment.—In the *Mining and Scientific Press* for January 24, C. F. Tolman Jr. reviews recent contributions to the literature relating to secondary sulphide enrichment.

Gaylussite.—In the *Mining and Scientific Press* for February 7, E. E. Free describes the occurrences of gaylussite, the double carbonate of lime and soda, and discusses the possibility of using deposits for the manufacture of soda compounds.

Tin in Bolivia.—The *Mining and Scientific Press* for February 7 contains an article by G. W. Wepfer enumerating the companies working tin mines in Bolivia and describing the various deposits worked.

Radium in United States.—Bulletin 70 of the United States Bureau of Mines contains a preliminary report on the uranium, radium, and vanadium deposits in Colorado and Utah, prepared by R. B. Moore and K. L. Kithil.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be obtained on application to The Mining Magazine.

NEW BOOKS

With the Russians in Mongolia. By H. G. C. Perry-Ayscough and R. B. Otter-Barry. Cloth, octavo, 350 pages, illustrated. London: John Lane. Price 16s. For sale at the Technical Bookshop of *The Mining Magazine*.

At the present time Northern Asia is attracting the attention of many mining engineers in Europe and America. Siberian ventures occupy a large share of public interest in England and France. Korea provides opportunities for investment in England, France, and America. Hitherto Manchuria and Mongolia have been countries comparatively unknown to our circle of readers, only a few having made their personal acquaintance. The pages of the Magazine have been enriched by contributions from Messrs. J. P. Hutchins, D'Arcy Weatherbe, Stanley de la Mare, C. W. Purington, and others, describing mining operations and general conditions in Southern Siberia and Manchuria, but with the exception of Mr. Weatherbe's article relating to the Russian treaty with Mongolia, little has been published about that State. We are glad, therefore, of having the opportunity of drawing attention to a new book describing the country. It is a composite production, built partly on the diaries of two travellers, who made separate journeys at different times. They have had the assistance of the Russian representative in Mongolia, Ivan Korostovetz, and of Sir Claude Macdonald, the British Ambassador first at Peking and afterwards at Tokio. Dr. Morrison, the political advisor to the Chinese government, has also lent the authors his assistance. We may take it therefore that the book is of standard authority and not an off-hand compilation by an irresponsible globe-trotter.

The general under-current of the book is an examination of the political influence that Russia has already gained in Mongolia and of its probable extension. When Russia was beaten out of Manchuria, her pioneers of empire sought another plan for bringing her influence to bear on the eastern seas and obtaining a share in the councils of the Chinese government. Her plan was to take a southward instead of the easterly course, and the newly created independence of Mongolia afforded the opportunity. The country provides a very short cut to Peking, and the political relations between China and Mongolia are strained. In the meantime the treaty between Russia and Mongolia clearly defines the military and trade relations between the two. As far as mining is concerned, the Russians receive unlimited rights, so that in future any outsider desiring to embark on mining operations practically can only do so under Russian control.

AT THE ALLUVIAL GOLD MINES ON THE YERO RIVER, MONGOLIA.

The first few chapters of the book give a historical account of the relations of Russia and Mongolia, and an account of the Mongol race, and subsequent chapters written by the authors in collaboration describe the finance, commerce, agriculture, religion, and education of the Mongols. The remainder consists of the diaries of the two authors, recording their observations during the journeys. The alluvial gold mines at Yero near the Siberian border not far from Lake Baikal are described briefly, and without technical details. By the courtesy of the publisher we are able to reproduce one of the pictures giving a view of the gold-washing operations. The book is embellished by fifty excellent photographs and a useful map.

Oil Production Methods. By Paul M. Pain and B. K. Stroud. Cloth, octavo, 240 pages, illustrated. San Francisco: Western Engineering Publishing Co. Price 12s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

We have had many books on petroleum, excellent in their way, but this is the first devoted solely to the details of the drilling and fitting of oil-wells. Even this section of the subject is a large one, and the authors were wise therefore not to attempt to do more than give the practice on the Pacific Coast. We have to thank our enterprising young contemporary *Western Engineering* for the publication of this useful book, and we would take this opportunity of saying that our contemporary always contains in its pages a great deal of matter of value to the oil engineer. The book commences with a short chapter on the distribution, properties, and uses of petroleum, and the second deals briefly with the geology, surface indications, and the placing of wells. The bulk of the book is devoted to descriptions of rigs and equipment, various methods of drilling, devices for excluding water from oil-sands, the management of wells, raising the oil by pumping, handling the oil, recovering lost tools, etc. A final chapter deals with accounting systems, and has been written by W. F. and W. B. Sampson, accountants with special experience with oil companies. The book is a mass of details and hints connected with everyday practice, and is a worker's and not a theorist's guide.

The Coal Resources of the World. Edited by William Mc Innes, P. B. Dowling and W. W. Leach. Three volumes, quarto, with a portfolio of maps. Toronto, Canada: Morang & Co. Price 5 guineas. For sale at the Technical Bookshop of *The Mining Magazine*.

This magnificent work was prepared for the Twelfth International Geological Congress, held in Canada during 1913, by members of the Canadian Geological Survey, with the assistance of a great number of geologists throughout the world, holding official positions and otherwise. The coal resources of each country are described and the geological details of the occurrences given, as also are estimates of the probable reserves, and the characteristics of the coal, with analyses. Very properly some of the less known but promising countries are alloted a proportionately large number of pages. For instance the coal resources of China, Korea, Manchuria, and Japan are described exhaustively. The maps and geological diagrams in the separate folio are excellent in quality, and greatly add to the value of the work. The text also contains many additional illustrations. The volumes will form the standard work of reference for years to come.

Russian Mining Regulations. Translated from official sources by J. Harper. Cloth, octavo, 155 pages. London: *The Mining Magazine*. Price 5s. net.

This book gives the general regulations relating to safety in metal-mining operations provided by Russian mining law. It should prove of great service to engineers and companies at work in the Russian Empire. An unfortunate habit of strangers in any country is to omit to study the laws and customs before beginning business. In the case of Russia, there are extenuating circumstances to be pleaded as regards nonconformity to mining regulations, for the laws are published only in the language of the country, a language not generally included in the curriculum of studies at European or American schools. Naturally the iritation caused by this lack of conversance with the law is apt to cause a contempt for it, but directly the details are fully understood, the law is found to be reasonable and the modifications of practice necessary to conform with it quite simple and easily effected. Hitherto acquaintance with the details has been only possible by means of a study of the language or by the delegation of duties relating to management to a Russian engineer. We have to thank Mr. Harper, therefore, for providing us with an authoritative translation of the regulations, which will enable English and American engineers to study them at first hand. This is, however, not the only value we attach to the book. Its application is even wider, for it provides the opportunity of studying the mining regulations of the Russian Empire in relation to the regulations of other countries. It will thus help greatly in the ultimate formulation of general laws throughout the world having for their object the improvement of working conditions underground.

The Mining Manual and Mining Year Book for 1914. By Walter R. Skinner. Cloth, octavo, 1240 pages. London: Walter R. Skinner, and *The Financial Times*. Price 15s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

It is always a pleasure to welcome an old and trusty friend. During the twenty seven years of the 'Mining Manual's' existence, the editor, Walter R. Skinner, has maintained an excellent standard of accuracy and usefulness. Everybody ought to know this yearbook by now, but for the benefit of those who do not, we may say that it contains details of all the mining companies registered or doing business in Great Britain, telling of the nature of the mines, the capitalization, the income, expenditure, and dividends, the directorate and leading officials. From our own point of view, the back numbers are of as great interest as the current issues. A complete set of Skinner affords an excellent history of mining operations directed from London since 1887. We regret to say that our own set is incomplete, owing to the volume for 1893 being missing, and we should be glad if any of our readers could help us to fill the vacant place on our shelves.

Quantitative Analysis. By Edward G. Mahin, associate professor of chemistry in the Purdue University, Lafayette, Indiana. Cloth, octavo, 510 pages, illustrated. New York: McGraw-Hill Book Co. Price 12s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Economic Geology. By Charles H. Richardson, professor of mineralogy and economic geology in the Syracuse University, New York. Cloth, octavo, 315 pages, illustrated. Price 10s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This work cannot be taken as a standard text-book, though it contains many new instances not found elsewhere, for the want of wide personal acquaintance of characteristic orebodies has led the author into numerous errors. Moreover the literary style is weak, and often the meaning is obscure.

Mine Surveying. By Edward B. Durham, associate professor of mining in the University of California. Leather, small octavo, 390 pages, illustrated. New York: McGraw-Hill Book Co. Price 15s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

COMPANY REPORTS

South Crofty.—This company was formed in 1906 under limited liability by the Allen-Meyerstein group to acquire the South Crofty mine between Camborne and Redruth that had previously been worked by a cost-book company. The capital is £50,000 in shares of £1 each; 20,000 were issued credited with 15s. paid to the shareholders in the old company; 20,000 were subscribed at par by the promoters; and 10,000 were subscribed by the public at £4 each. Dividends were first paid in 1909, when 15% was distributed, and the rates for succeeding years have been 15, 35, 40, and 35%. Josiah Paull is the manager. The report for the year 1913 now published shows that 69,366 tons of ore was raised and milled, as compared with 66,076 tons during 1912, and that the yield was 633 tons of tin concentrate, 117 tons of wolfram, and 744 tons of arsenic, as compared with 627 tons, 130 tons, and 986 tons respectively. The income received from the sale of the three products was £78,442, £11,008, and £10,635, making a total of £100,084, as compared with £82,481, £11,148, £9887, and £103,416. The yield per ton of ore milled was 20·45 lb. tin concentrate, 3·78 lb. wolfram, and 24 lb. arsenic, as compared with 21·28 lb., 4·42 lb., and 33·45 lb. The total realized value per ton was 28s. 10d. as compared with 31s. 4d. per ton. The average prices per ton received during the year were £125 for tin concentrate, £93 for wolfram, and £13 for arsenic, as compared with £130, £86, and £9. The mining cost was £77,512, and the London expenditure £2612, while £2815 was allowed for depreciation. The shareholders received £17,500, being at the rate of 35%. The company has a cash reserve of £25,000. Development work amounting to 4588 ft. was done during the year. Unfortunately the ore exposed has been of low average grade, especially in the New Cook's section, where nothing worth working at present has been disclosed.

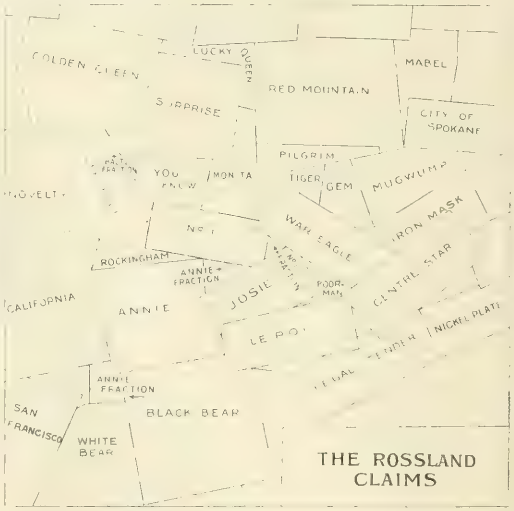
Grenville United Mines.—This company was formed in 1906 under limited liability to acquire the Grenville mines situated to the south of Camborne, which had previously been worked on the cost-book system. Much active development has been done by the manager, Henry Battens, and substantial dividends have been paid. During the last year or so, the yield per ton of ore treated has been decreasing, having been 39 lb. during the half-year ended December 31, 1912, 36·9 lb. during the half-year ended June 30, 1913, and 34·7 lb. during the half-year ended December 31 last; the output of concentrate during these periods was 368 tons, 349 tons, and 315 tons. The report for the half-year ended December 31 shows that the ore crushed amounted to 21,770 tons, and the income from the sale of concentrate, 315 tons, was £36,093. The divisible profit was £5668 as compared with £14,445 during the previous half-year. The decrease was due not only to the smaller output, but to the lower price of tin, the average price obtained for the concentrate having been £108 per ton as compared with £137. The shareholders received £4386, being 5% for the half-year. Mr. Battens gives details of the developments. Though some points have not given as good results as hoped, the general prospects are satisfactory. The chief work is being done on the 2010-ft., 2130-ft., and 2250-ft. levels.

Dolcoath Mine.—The report of the premier tin mine of Cornwall for the second half of 1913 shows that the yield of concentrate per ton of ore continues to decrease. The figure was 29·3 lb. per ton, as compared with 30·2 lb. during the first half of the year, 32 lb. a year ago, and 79 lb. during the present company's first half-year ended December 1895. The amount of ore milled was 56,409 tons, as compared with 58,304 tons during the previous half-year, and 60,631 tons a year ago, and the yield of concentrate was 738 tons as compared with 786 tons and 868 tons respectively. Owing to the drop in the price of tin, the receipts were only £79,672, as compared with £105,964 and £119,486, the average price of black tin having been £107 as compared with £134 and £137. Other items of revenue brought the total income to £80,736. The working cost was £65,293, and the lord's royalty £5311, leaving a profit of £10,131, out of which £4966 was written off for depreciation, leaving a divisible profit of £5165. Bringing £16,858 forward from the previous year, there was a disposable balance of £22,023. Out of this, £8750 has been distributed as dividend, being at the rate of 6d. per share. The dividend for the first half of the year was double this, and the total dividend for 1913 was 7½%. During the half-year, the developments in depth have been generally unsatisfactory. The drift on the Entral lode at the 1260-ft. level has not come up to expectations so far, but of course only a small part of the length of the lode has been explored. Results to be obtained at the intersection of the lode at the 1140-ft. and 1380-ft. levels are anxiously awaited.

Jantar Nigeria.—This company was formed in May 1912 to acquire alluvial tin ground, from G. R. Nicolaus and the Northern Nigeria (Bauchi) Tin Mines, situated 3 miles from Naraguta at the head of Curly and Niger creeks. H. Douglas Allen is manager. The report now issued covers the period from the inception of the company to September 30 last. During this time, 216 tons of concentrate was recovered, averaging 75% metal. The accounts show a net revenue from the sale of concentrate of £22,408, and a net profit of £8943. Out of this, £6000 has been distributed as dividend, being at the rate of 10%. Mr. Allen gives particulars of prospecting work done on the properties, whereby 1000 tons of concentrate has been proved.

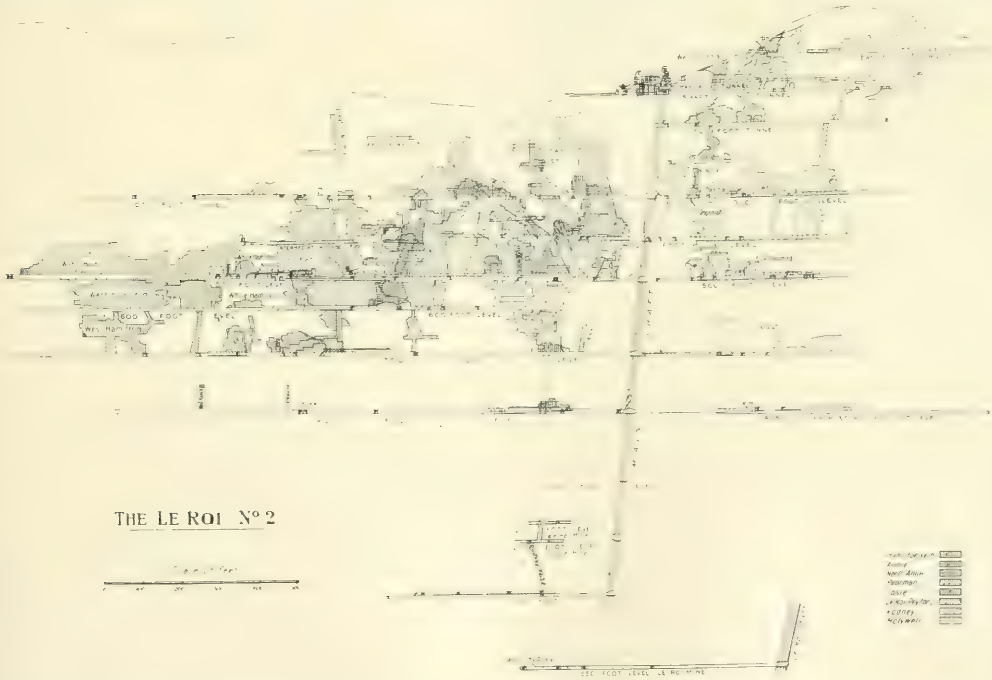
Chenderiang Tin Dredging.—This company has been formed to consolidate two local companies owning adjoining alluvial tin lands in the Chenderiang valley, at Jabus near Temoh, in the state of Perak, Federated Malay States. The control is in the same hands as the Kamunting Tin Dredging Co. M. T. Nelmes Bluck has examined the properties and reports that they have been worked by Chinese. William Simons & Co. are building a bucket-dredge to work the property, with a capacity of 80,000 cubic yards per month, and capable of digging to a depth of 40 ft. A hydraulic-elevator and monitor plant has also been provided. The total area is 877 acres. The results of boring indicate an average content of 1·2 lb. black tin per cubic yard, and the total cost (not dredging cost) of 7½d. per yard. The capital of the company is £120,000 in shares of £1 each, of which 51,000 are issued as purchase price and 41,000 are offered for subscription. The vendors also take £23,500 cash. It is intended to build a second dredge later.

Le Roi No 2.—This company was formed in 1900 during the Whitaker Wright boom to acquire the Josie, Poorman, Annie, and other claims at Rossland, British Columbia. The adjoining Le Roi, floated shortly before, now belongs to the Consolidated Mining & Smelting Company of Canada, the owner of the Centre Star and War Eagle mines. After the collapse of the boom, the company was taken in hand by Lord Ernest Hamilton and his friends, and the management was placed with Alexander Hill & Stewart, whose representative on the spot has been Ernest Levy. After



THE ROSSLAND CLAIMS

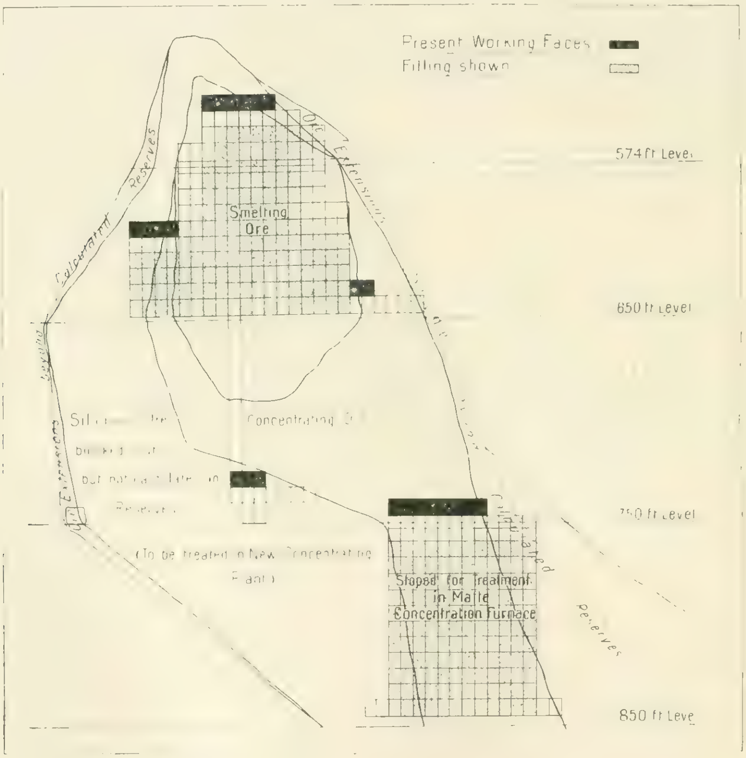
the change of proprietory of the Le Roi, litigation was threatened as to the ownership of certain veins, under the law of extra-lateral rights, but fortunately the two companies settled the dispute amicably. Arrangements have since been made whereby the deep levels of the Josie mine can be developed from the Le Roi. During the last ten years or so, profits have been made, which though satisfactory in themselves look small when the high capitalization, £600,000, is considered. Of course the present board is not responsible for the inflation of capital; it was a legacy of previous irresponsible optimism. Moreover, the ore-shoots and their contents have been irregular, and large sums have always had to be spent on prospecting and development. As will be seen from an inspection of the accompanying vertical section, many lodes and ore-shoots have been worked. The report for the year ended September 30 last shows that 51,625 tons was raised, and after the rejection of 16,072 tons waste, 19,023 tons was shipped to the smelter, and 16,530 tons sent to the concentrating plant. The shipping ore averaged 12·8 dwt. per ton, 1·2 oz. silver per ton, and 1·94% copper. The low-grade ore averaged 2·4 dwt. gold per ton, and 0·55% copper, and from it was produced 1595 tons of concentrate averaging 16·3 dwt. gold, 0·6 oz. silver, and 0·9% copper. The sale of ore and concentrate brought an income of £53,643. The net profit was £1598, which was carried forward. This is the first time that no dividend has been earned, though for the previous year the dividend of 1s. per £5 share was provided partly by the balance in hand. The gold output of 13,500 oz. is less than half what it was during the years 1907 to 1911. The most important development done during the year was on the Rodney orebody on the 1500 ft. level. This ore is being attacked from the Le Roi shaft, as shown in the illustration. The development ore has paid for the work, and the prospects are decidedly promising. The winze now being sunk is disclosing ore 22 ft. wide averaging $16 per ton. On the 600-ft. level of the Annie lode, west of the White dike, an ore-shoot, numbered 37, has proved to be of unusually high grade. The content is maintained down to the 700-ft. level, but the continuation of the shoot on the 900-ft. level has given disappointing results. The company owns an interest in the Van-Roi mine, particulars of which are given in the succeeding paragraph



Van Roi.—This company was formed in 1908 as a subsidiary of the Le Roi No 2, for the purpose of acquiring the Vancouver group of silver-lead-zinc properties in the Slocan district of British Columbia. The capital is £34,500, divided into 30,000 preference shares of £1 each, and 90,000 ordinary shares of 1s. each. The purchase price was £20,000 cash paid to the local owners and 60,000 ordinary shares allotted to the Le Roi No. 2. The preference shares are entitled to one quarter of the profits. All the preference shares and 30,000 of the ordinary shares were sold to shareholders in the Le Roi No. 2. No dividend has been paid. At first the ore was concentrated in the Wakefield mill, which was leased for the purpose. Subsequently the company built a mill, at which operations were started in March 1911. The report for the year ended September 30 last shows a great decrease in the ore mined, being 25,702 tons as compared with 54,115 tons the year before. It became necessary to resort to diamond-drilling in order to trace the main lode. The results so far obtained are not conclusive, though they indicate the existence of a northerly branch, which is to be further explored. The 25,702 tons raised averaged 8·3 oz. silver per ton, 2·28% lead, and 5% zinc. The output of the mill was 688 tons of lead concentrate averaging 145 oz. silver per ton, 56·8% lead, and 11% zinc, and 841 tons of zinc concentrate averaging 47 oz. silver per ton, 4% lead, and 44% zinc, a total of 1549 tons of concentrates, which sold for £15,224. Other revenue and credits brought the total income to £15,852. The total expense was £36,411, so that the result of the year's work was a loss of £20,559. A year ago the income from the sale of 4962 tons of lead and zinc concentrates was £71,217, and a net profit of £26,742 was made. It is obvious that the present position of the company is an anxious one.

Arizona Copper.—We have on several occasions reviewed the history of this company, which was formed in 1882 in Edinburgh to work the Longfellow and Metcalf groups of copper mines in the Clifton district, Arizona. Large profits have for many years been made on comparatively low-grade ore containing little or no precious metal. In order to make it possible to treat the extensive reserve of lower grade ore, it was decided in 1911 to build a new smelting plant and extend the concentrators. This work has been done under the advice of L. D. Ricketts, and the oil-fired reverberatories are of the Cananea type. To provide the necessary capital, £400,000 debentures were issued and other funds amounting to £125,000 were provided out of revenue. The report now published covering the year ended September last shows that the cost has exceeded the original estimate by £103,000, the increase being due largely to further extensions to the concentrators and additions to the smelting plant. Additional cost has been involved by the faulty construction of the furnace bottoms, the partial rebuilding of which has also caused delay in the completion of the plant. It is proposed to allocate £130,000 out of the past year's profit for the purpose of providing the additional funds required. The report announces that two of the new furnaces have been started and that the third is in readiness whenever required. Operations at the old smelting plant were ended on December 31 last. During the year under review 936,903 tons of ore was mined yielding 17,113 short tons of copper, being 1960 tons of copper less than during the previous year; the decrease was due to the lower grade of the ore mined, the yield per short ton being 38·76 lb. as compared with 41·15 lb. the previous year. Of the Longfellow group of mines, the Humboldt provided 449,506 tons of ore, and the Coronado 114,441 tons, other smaller mines bringing the output of the group to 669,513 tons. The Metcalf group produced 266,390 tons. About 5% of the total ore was sulphide and oxide, suitable for despatch to the smelters; 106,596 tons was oxidized ore that was first concentrated and the tailing leached with acid; the amount of sulphide ore sent to the concentration plant was 780,887 tons. The smelting furnaces treated 151,265 tons of ore and concentrate. The accounts show an income of £1,083,070 from the sale of copper and copper sulphate, and of £72,786 from dividends derived from the working of the railway. The balance of profit was £406,035, out of which £130,000 was placed to capital account, £29,124 paid as interest on debentures, £2374 as dividend on 'A' preference shares, and £22,157 on preference stock. By adding the balance, £39,260, brought forward from the previous year, a disposable profit of £222,380 was available for the ordinary shares, and of this £208,985 has been distributed, being at the rate of 2s. 9d. per 5s. share, or 55 per cent.

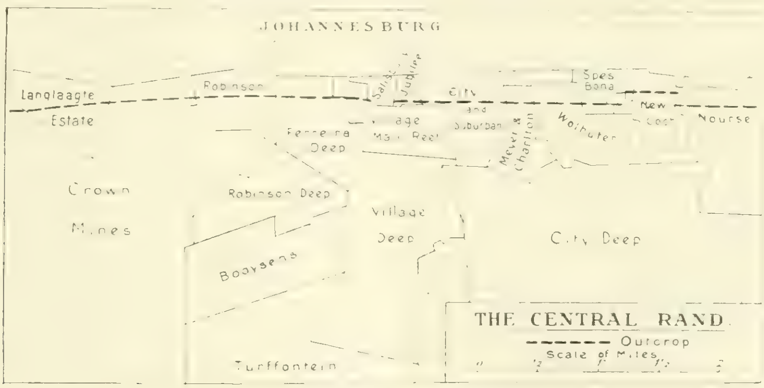
Mount Morgan Gold Mining.—We have on many occasions given the history of this great gold and copper mine in Northern Queensland, and we need not recapitulate here. The report for the half-year ended November 30 last shows that the building of the modern smelting plant has been delayed owing to the non-delivery of material, and that break-downs in the power-house of the old smelter have caused a reduction in the amount of ore treated. The experimental work with regard to concentration has not yet been completed, and in the meantime some of the lower-grade ore is being smelted direct. The smelters treated 123,247 tons, of which 36,623 tons was low-grade ore, together with 25,632 tons of Many Peaks pyritic ore. The yield was 4354 tons of copper and 54,992 oz. gold. The average yield of the Mount Morgan ore was 3⅛% copper and 8·5 dwt. gold. The revenue for the half-year was £496,935; the working cost was £324,090, and £52,590 was written off for depreciation, etc. The shareholders received £100,000, being 10% on the capital, £1,000,000. The illustrations given herewith show a corner of the mine and how it has been necessary to stope ore not reckoned in the reserve. It will be noticed that below the 650-ft. level there is a large block of highest-grade smelting ore. The most economical method of mining this is to sink the winze from the 650-ft. level to the 750-ft. level and stope upward. This method involves breaking a large quantity of concentrating ore and silicious ore. The reserve



Vertical Section of part of Mount Morgan Orebody.

on November 30 was estimated at 3,245,000 tons of smelting ore, and 3,000,000 tons of ore suitable for concentration.

Associated Northern Blocks.—This company was formed in 1899 to acquire the Iron Duke and adjoining leases at the northern end of the 'Golden Mile,' at Kalgoorlie, West Australia. The control is in the same hands as the Associated Gold Mines, and Hermann Landau is chairman. Until three years ago, the management of the two companies was in the hands of George M. Roberts. Since then Mr. Roberts has confined his attention to the Northern Blocks, and Duncan F. McAulay has been in charge of the Associated Gold Mines. The Iron Duke is practically exhausted, and is being worked by tributers. Two years ago the company acquired the Victorious property at Oro Banda, 35 miles north of Kalgoorlie, and commenced milling the oxidized ore in September 1912. The report now issued covers the year ended September 30 last, and shows that the tributers raised 17,963 tons of ore from the Iron Duke, and this together with 5922 tons of purchased ore was treated at the mill. The royalty accruing to the company was £16,417. In addition 32,276 tons of residue was treated, yielding a profit of £1260. At the Victorious mine, 97,639 tons of ore was raised and treated by all-sliming and cyaniding for a yield of gold worth £108,370. A small amount of sulphide ore and concentrate, and slag was produced, yielding gold worth £1576, bringing the total yield to £109,946. The company's profit for the year was £72,995, out of which £25,703 was written off development account. After allowance for administration expenses and taxes was made, the divisible profit was £38,452, and £35,000 was distributed to the shareholders, being at the rate of 10%. The directors' report is accompanied by one by Edward H. Liveing, the consulting engineer, who has recently returned from a visit of inspection. He states that the orebody on the 5th level has a favourable appearance, and that the grade of the sulphide ore is much higher than that of the oxidized ore. Between the 5th and intermediate level below, much of the sulphide ore assays 60s. per ton. Owing to the irregular width of the shoots and the patchy distribution of the gold, it is difficult to fix a figure for the ore reserve. Mr. Liveing would have preferred to prove more ore below the 6th level before recommending the erection of accessory plant to treat the sulphide ore, but as the available oxidized ore is limited, he considered it best to advise the erection of roasting furnaces at once, so as to have as little break as possible in the output. The company also owns the El Refugio at Salinas, Zacatecas, Mexico. Owing to the political conditions, it has been deemed advisable to lease it locally, but no work has been started as yet.



Wolhuter Gold Mines.—This company was formed in 1887 to acquire claims on the outcrop in the central part of the Rand. Many rearrangements of the property and of deep levels connected therewith have been made, and for a long time the career of the company was a chequered one. In fact the payment of substantial dividends was only commenced in 1910, though small ones were paid in the years 1894 to 1898. The control is with the Neumann group, David Wilkinson is consulting engineer, and J. E. McGuire is manager. The report for the year ended October 31 last shows that 383,921 tons of ore was raised, and after the rejection of waste, 340,950 tons was sent to the mill. The yield was £325,681 by amalgamation and £124,718 by cyaniding, a total of £450,399, or 26s. 5d. per ton milled. The working cost was £311,000 or 18s. 3d. per ton, leaving a profit of £139,398, or 8s. 2d. per ton. The tonnage milled was 6100 less than the previous year, the yield per ton 1s. 4d. less, the cost 10d. per ton more, the profit per ton 2s. 2d. less, and the working profit £40,091 less. The cost of mining has been increased by the broken nature of the ground in the eastern section. As regards development, the results on the South Reef have been disappointing, but the Main Reef Leader has been consistently good. The ore reserve on October 31 was estimated at 784,100 tons averaging 6·1 dwt. per ton over 51½ in., a decrease of 48,877 tons as compared with the year before. Out of the £139,398 working profit, £29,369 was allocated to capital expenditure on plant and shaft-sinking, £1000 was paid as extra remuneration to the directors, £14,613 as profits tax, £7931 as an instalment of the purchase price of undermining rights, and £5749 as contribution to the miners' phthisis fund. The shareholders received £86,000 as dividend, being at the rate of 10 per cent.

Exploration Company.—This company was formed in the year 1886 by Hamilton Smith and E. G. de Crano for the purpose of examining and floating mining properties. It had the financial backing of the Rothschilds, Barings, and other bankers and brokers in London. After the death of the original promoters, a period of misrule supervened, but shortly afterward, R. T. Bayliss was appointed to the management, and he restored its credit and some of its prestige. The report for 1913 shows that the company has been hard hit by the disorders in Mexico and by the depression in financial circles and on the Stock Exchange, and the directors are not in a position to declare a dividend. Owing to the suspension of dividends by many of the companies in which shares are held, the gross income for the year was only £30,393, as compared with £80,644 the year before. After deducting administration expenses, a net profit of £10,058 was left. Owing to the fall in the market quotations of the shares held, the 'sundry investments' item in the balance-sheet has shrunk by £64,487; and now stands at £579,806. For the first time, the report gives some details of the holdings though not specifying the amount of each. The aggregate holding in the El Oro and Buena Tierra companies operating in Mexico is returned at £88,221, and that in the Tomboy (Colorado) and Natomas Consolidated (California) at £88,497. Holdings in the Greene-Cananea and Chile Copper company (the latter owning the Chuquicamata deposits) amount in the aggregate to £162,810.

Owing to the serious position in Mexico, the subsidiary, the Exploration Company of England and Mexico, formed to conduct search and development work in Mexico, was forced to suspend operations in January 1913, as the conditions in the country made it quite useless to spend any more money there. The El Oro company has fortunately so far been able to continue operations, and the physical condition of the mine shows improvement, but the directors have considered it best to suspend the payment of dividends. The Buena Tierra mine, in Chihuahua, has been in the centre of the conflict in the northern states, and though it was not itself in a vulnerable position, operations have only been intermittent, and the smelter to which the ore is shipped has not been running regularly. The latest advice is to the effect that the smelter resumed operations on February 1. The Santa Rosa mine in Zacatecas is in a more serious plight, for the destruction of the railway made it necessary to stop construction work in April last, and all development ceased in December. The property is now in the hands of caretakers, and so far is uninjured. It is particularly unfortunate that this cessation has been necessary, for the metallurgical difficulty that at first threatened has been overcome, and the mine is developing beyond all expectations.

The copper interests of the Exploration Company have been increased by £87,000 by the purchase of convertible bonds in the Chile Copper Company, which operates the Chuquicamata mine in Chile. Chuquicamata is undoubtedly one of the world's greatest deposits of copper, for it is estimated that upward of 200,000,000 tons of ore averaging over 2% copper has already been proved, the copper occurring as brochantite. The mine is controlled by the Guggenheims, and Fred Hellmann is manager. The money necessary for the equipment of the property with a plant of 10,000 tons daily capacity has recently been provided by the issue of convertible bonds, and it is expected that the plant will be in operation some time during 1915. This plant should produce 120,000,000 pounds of electrolytic copper per year, at a cost not exceeding 6 cents per pound delivered at European ports. With copper at 14 cents per pound the yearly profit would be £2,000,000.

Tasmania Gold.—This company was formed in 1903 by John Taylor & Sons to acquire a group of gold mines near Launceston, Tasmania, that had previously been worked by local owners. These mines had been successful until the great increase in the flow of water at depth made it necessary to suspend operations. On flotation in London, large sums of money were provided for the erection of pumps and for the continuation of development work on an extended scale. In spite of the enormous capacity of the pumps, water troubles recurred, and another cause for anxiety was the decline in the grade of ore. It was necessary to reconstruct in 1910, when the capital was reduced from £500,000 to £250,000 by writing down the £1 shares to 10s., and issuing them credited with 7s. 6d. paid. In this way £62,500 additional capital was raised. The report for the year ended September 30 last now issued announces that the mine is to be shut-down. During the year, 53,812 tons of ore was raised and milled, yielding 21,174 oz. gold worth £89,767. The loss for the year was £3028. No further call has been made on the shares, the amount paid up being 8s. 6d. The amount of development done was 3231 ft, chiefly on the deepest levels, at 1370 ft. and 1500 ft. On the 1370-ft. level, for 1265 ft. the lode averaged 7 ft. wide and the content $8\frac{3}{4}$ dwt. per ton gold. On the 1500-ft. level, 940 ft. was in ore 7 ft. wide averaging 13 dwt. Though the grade of the ore has increased, its character has changed, and only a small percentage of the gold is amenable to amalgamation, more gold going into the concentrate and slime. This, taken with the fact that the average stoping width in the mine is 50% greater than the assay width, makes the ore in the lowest levels unprofitable. This is disappointing, for it was hoped that the less productive zone might eventually give place to a more profitable as increased depth was attained. It does not necessarily follow that that might not eventuate were the mine to be further deepened. In the report last year the directors foreshadowed a scheme for resumption of sinking operations, should the position and prospects at the 1500-ft. level, then in progress, warrant the outlay. Since then the rate of wages in Tasmania has again been increased, and it is now calculated that, with the £25,000 that would have to be expended on the necessary plant to sink the new inclined shaft below the 1500-ft. level, the total cost of opening a new level 100 ft. deeper would be at least £90,000. C. F. Heathcote, the manager, at the time of the preparation of his annual report, had definitely come to the conclusion that, in view of the more restricted and less productive orebodies encountered in depth, and the absence of the necessary encouragement to incur the great outlay required to follow the lode below the 1500-ft. level, he had no alternative but to recommend that the mine be closed-down; that such parts of the pitwork as will pay for removal be withdrawn as soon as the best of the ore now in sight is exhausted, and that, while the accumulated concentrate and slime are being treated in the grinding plant, the company's assets be realized as opportunity permits. In November 1913, prior to the receipt of Mr. Heathcote's report, John Taylor & Sons, the managers, instructed their Arthur Llewellyn to examine the mine. Mr. Llewellyn cabled in January that he confirmed the opinion expressed by Mr. Heathcote, that the mine would not justify the large expenditure necessary to sink deeper, and that developments should be discontinued. The directors cabled to the superintendent at the end of January to act accordingly. The profitable sections of the ore reserves will, it is expected, be extracted by the end of April, and all the pump work that can be removed from the shafts will be brought to surface and the mine closed-down. At surface the treatment of the large accumulation of slime and concentrate will be continued, and it is probable that this work will occupy four or five years. The gold contents of this material should yield a substantial profit. It is feared that the disposal of the machinery may be a difficult matter. The company has £37,500 uncalled capital and on September 30 cash resources amounting to £15,167. The advisability or otherwise of seeking a new property is under consideration by the directors and shareholders.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Managing Director.

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CONTENTS.

STATISTICS

Stocks of Copper in England and the Continent.
Reported by Henry R. Merton & Co. Tons of 2240 lb.

	Jan. 31 Tons	Feb. 28 Tons	Mar. 31 Tons
In England	10,419	10,399	9,948
In France	1,712	1,576	1,791
Afloat from Chile	1,700	2,750	2,350
Afloat from Australia	3,000	3,800	3,800
In Rotterdam	3,650	3,300	3,200
In Hamburg	3,842	3,994	3,947
In Bremen	1,621	1,134	1,093
In other European Ports	750	700	600
Total European visible supply	26,694	27,653	26,729

American Copper Producers' Association's Figures.
In Tons of 2240 lb.

	Production.	Deliveries			Stocks at end of month
		Domestic	Foreign	Total	
Total, 1911	639,258	316,791	337,009	653,800	—
Total, 1912	706,052	365,920	333,212	699,132	—
March 1913	60,822	34,190	34,682	68,872	46,550
April	60,416	34,892	38,346	73,238	33,728
May	63,088	36,209	30,477	66,686	30,130
June	54,402	30,559	30,396	60,955	23,577
July	61,640	26,296	35,035	61,331	23,886
August	58,764	32,897	32,706	65,603	17,064
September	58,661	29,837	32,627	62,464	13,261
October	62,085	30,435	30,412	60,847	14,499
November	59,860	21,721	31,280	53,001	21,358
December	62,049	9,794	32,831	42,625	40,782
Total 1913	724,307	342,566	387,974	730,540	—
January 1914	58,826	21,409	39,266	60,675	38,933
February	54,715	21,244	37,455	58,699	34,949
March	65,023	31,184	39,983	71,167	28,805

Production of Gold in the Transvaal.

	Rand	Elsewhere	Total	Value
	Oz.	Oz.	Oz.	£
Year 1912	8,753,563	370,731	9,124,299	38,757,560
March 1913	760,324	30,228	790,552	3,358,050
April	755,858	29,116	784,974	3,334,358
May	761,349	32,957	794,306	3,373,998
June	716,267	30,810	747,077	3,173,382
July	625,107	30,282	655,389	2,783,917
August	697,686	30,410	728,096	3,092,754
September	676,411	29,775	706,186	2,999,686
October	687,515	30,916	718,431	3,051,701
November	644,320	29,166	673,486	2,860,788
December	642,786	30,029	672,815	2,857,938
Year 1913	8,430,998	363,826	8,794,824	37,358,040
January 1914	621,902	29,851	651,753	2,768,470
February	597,545	28,716	626,261	2,660,186
March	657,708	29,093	686,801	2,917,346

Cost and Profit on the Rand.

	Tons milled	Yield per ton	Cost per ton	Profit per ton	Total profit
		s. d.	s. d.	s. d.	£
Year 1912	25,486,361	29 2	19 3	9 11	12,678,095
Year 1913	25,628,432	27 9	17 11	9 6	12,189,105
January 1914	1,902,733	27 4	18 2	9 3	876,577
February	1,861,442	26 10	17 11	8 10	823,654

Gold Output of India.

Year 1912	Year 1913	Mar. 1914	Year 1914
£2,265,094	£2,299,315	£191,853	£570,501

Production of Gold in West Africa.

Year 1911 £	Year 1912 £	Year 1913 £	Feb. 1914 £	Year 1914 £
1,069,442	1,497,179	1,634,700	123,169	252,031

Natives Employed in the Transvaal Mines.

	Gold mines	Coal mines	Diamond mines	Total
January 31, 1913	200,090	8,789	13,912	222,791
February 28,	207,662	8,877	13,918	230,457
March 31	207,733	9,009	15,041	231,783
April 30	205,424	9,053	15,626	230,103
May 31	197,644	9,062	15,345	222,051
June 30	188,094	9,060	14,654	211,808
July 31	170,242	9,403	13,378	193,023
August 31	158,223	9,236	13,172	180,631
September 30	152,637	9,361	12,321	174,319
October 31	148,882	9,377	12,712	170,971
November 30	147,569	9,286	12,680	169,535
December 31	150,012	9,516	11,811	171,339
January 31, 1914	154,202	9,471	11,979	175,652
February 28	157,673	9,508	12,266	179,447
March 31	162,815	9,619	13,390	185,824

Production of Gold in Rhodesia.

Year 1911 £	Year 1912 £	Year 1913 £	Feb. 1914 £	Year 1914 £
2,647,894	2,707,368	2,903,267	259,888	508,920

Production of Gold in Western Australia.

	Export oz.	Mint oz.	Total oz.	Total value £
Total, 1910	363,496	1,209,856	1,573,352	6,682,042
Total, 1911	160,021	1,210,447	1,370,468	5,823,522
Total, 1912	83,589	1,199,080	1,282,669	5,449,057
Total, 1913	86,255	1,227,888	1,314,143	5,448,332
January, 1914	9,762	102,261	112,023	475,840
February	8,493	94,812	103,305	438,809
March	1,173	91,446	92,619	393,418

Other Australasian Gold Production.

	1912	1913	Feb. 1914	1914
	£		£	
Victoria	2,039,400	1,847,400	177,800*	276,090*
Queensland	1,484,160	1,118,610	74,940	224,040
New South Wales	702,129	635,703	38,873	151,997
New Zealand	1,345,115	1,345,131	115,088	364,804

* February figures only.

Nigerian Tin Production.
In tons of concentrate of unspecified content.

Year 1912 tons	Year 1913 tons	Feb. 1914 tons	Year 1914 tons
2,532	5,032	469	972

Production of Tin in Federated Malay States.
Estimated at 70% of concentrate shipped to smelters.

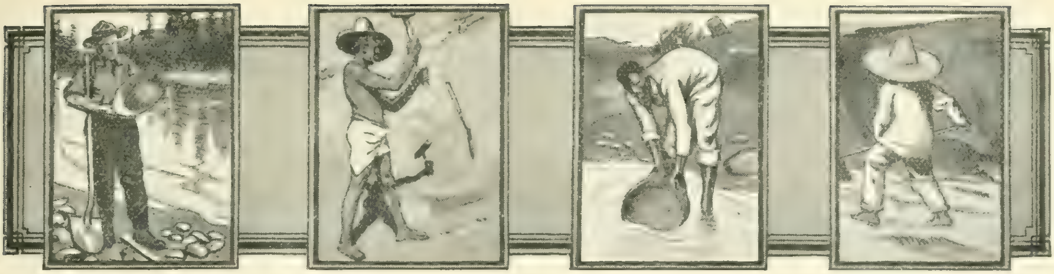
1911 tons	1912 tons	1913 tons	Feb. 1914 tons	Year 1914 tons
43,967	48,250	50,128	3,555	8,448

Sale of Tin Concentrate at Redruth Ticketings.

	Tons	Value	Average
Year 1911	6151½	£702,599	£114 4 5
Year 1912	6492	£831,908	£128 5 6
Year 1913	6186	£744,268	£120 2 6
January 5, 1914	202¾	£18,743	£92 13 6
January 19	232¾	£23,045	£96 6 6
February 2	231	£24,054	£104 2 7
February 16	232¾	£23,824	£102 11 7
March 2	234¼	£22,286	£95 2 9
March 16	214½	£20,726	£96 12 6
March 30	229½	£21,776	£94 17 8

Exports of Tin and Ore from Straits and Bolivia.
Reported by A. Strauss & Co.

	1912 tons	1913 tons	March 1914 tons	1914 tons
Metal from Straits to Europe and America	59,036	62,533	4,125	15,885
Metallic Content from Bolivia to Europe	21,149	24,843	2,854	5,904



REVIEW OF MINING

INTRODUCTORY.—The mining market is dull, in common with other departments of the Stock Exchange. Political conditions are responsible. The Carrancistas in Mexico and the Carsonistas in Ulster are equally subversive of business. Money is cheap, and signs of revival are recurrent, but the uncertainties in Ulster and Mexico are deterrent. A settlement of the Brazilian trouble would help Paris and Brussels. A better tone is apparent in the Kaffir market. Broken Hill is decidedly cheerful on excellent developments underground. The Rhodesian operators are trying to excite public interest in their performances. The Canadian department is depressed temporarily. Russian shares still afford a lively gamble. Nigerian tin ventures are suffering from too little water at the mines and too much of it in their shares. Tin mining in the Malay peninsula continues to look healthy. The Queensland copper companies are responding to unseen manipulation. Great Cobar is dead. Mexican mining is shrinking as brigandage spreads. The Indian mines have had cheerful meetings.

TRANSVAAL.—The gold and labour statistics for March exhibit decided improvement. The output of gold, worth £2,917,346, is the best since October, while the number of natives employed has increased 5142 as compared with February.

The president of the Chamber of Mines—Mr. John Munro—had to review a year full of incident. Out of the many subjects that he touched, we find those of drilling and ventilation of greatest interest. The small water-fed hammer-drill has proved a notable advantage in stoping; at the same time, the natives employed on machines have been encouraged to become more efficient by being given an increase of pay. Systems of artificial ventilation are being established at many mines, with a view to lessening the evil effect of the dust, which causes phthisis. Experiments in laying dust are being made, and no effort is being spared to mitigate the evil. Under the Miners' Phthisis Act no less than £1,098,136 has been paid as compensation to invalids during the 18 months ending in January.

In giving evidence before the Dominions Royal Commission, Mr. R. N. Kotze, the Government mining engineer, testified that the undeveloped area of the Rand would yield as much ore, that is, 587,000,000 tons, as remained in reserve in the productive mines. He estimated that £50,000,000 of capital would be required to bring the unexplored area to the productive stage. Mr. E. J. Way, as a representative consulting engineer, expressed the opinion that the cost of mining could be lessened by lifting the colour bar. He thought that the capital required for developing fresh territory would be at the rate of £1,000,000 per thousand claims.

The elections to the Provincial Council show large gains for the Labour party, but this is not deemed cause for anxiety among the mining companies because all the ordinances of this Council are subject to the proviso that they are not in conflict with any act of the Union Parliament. The success of the Labour candidate at the Liesbeck parliamentary by-election is more important, in so far as it signifies a popular dislike of the deportations without trial and the drastic provisions of the Peace Preservation Bill.

The mines of the Barnato group did well in 1913. In an earlier issue we have referred to the excellent technical and business management of this control. Last year eight out of the nine mines paid dividends aggregating over £750,000, two making their first distribution in the last quarter. We refer to the Consolidated Langlaagte and the Van Ryn Deep. The ninth property—the Government Areas—is in the development stage, and will become productive within twelve months. The New Rietfontein is the only bad spot; this mine had to reduce its dividend from 7½ to 2½% on a decrease of 1 dwt. per ton in the yield of gold. It is acknowledged that the prospects of this particular property are bad. We refer elsewhere to the excellent results obtained by the Consolidated Langlaagte, New Primrose, and Van Ryn Deep.

The Consolidated Langlaagte is one of the few mines on the Rand that has been able to add to its ore reserve since the labour troubles began last June. The property is worked in four sections, two above the Ferreira-Crown Reef dike and two below. The dike is on an upthrow fault, and the Main Reef Series is 1100 feet nearer the surface below the fault than above it. The finances of the company were re-arranged last year, a large block of shares being issued by the parent company, the Johannesburg Consolidated, as payment for money advanced.

The annual report of the Van Ryn Deep indicates good technical work and excellent prospects. A relatively low extraction—87½%—is explained largely by the treatment of dump material when starting the mill. Allowing for 15% sorting, the reserve consists of 1,660,000 tons of ore averaging 10 dwt. per ton.

The New Primrose report indicates good technical management. A small decrease in the yield of the ore is more than compensated by larger tonnage, less operating cost, and better metallurgical extraction. Sorting has been diminished to the point of extinction. An important fact is the proportion of ore obtained from 'reclamation,' that is, gleaned from old stopes. This, in 1913, amounted to 51% of the total tonnage milled, thus lengthening the life of the mine by conserving its resources.

The Modderfontein B made a handsome showing in 1913, decreasing the working cost to 16s. 4d. per ton, as against a yield of 38s. 9d. per ton, so that the nominal profit rose 2s. 9d., to 22s. 5d. per ton. The ore reserve is now 2,800,400 tons, averaging 34s. 10d., so that it is evident that ore above average was extracted. This is the only unpleasant feature in the report, although this feature is excused by the better grade of ore developed during the year.

The Brakpan report for 1913 is disappointing, as was inevitable, for causes made clear in these pages. However, the management has faced the music and told a plain unvarnished story. The normal yield is now put at 29s. per ton, but Mr. C. E. Knecht indicates a further lowering of grade to 26s. We note that the company includes 2,402,000 "unpayable tons" in its resources. Why play this farce? It is neither good technology nor good business. Unprofitable material is not an asset, and it is only misleading to allow it to masquerade as such.

The Simmer Deep, the second deepest on the Rand, 4780 feet vertical, is in a bad way. A loss of £5879 is reported for the first quarter of the year. The Main Reef Leader has proved most disappointing in this mine.

RHODESIA.—The output of gold in February constitutes a new record, of £259,888, or £9144 more than in January. The increase is due to the beginning of milling at the Cam & Motor and Shamva mines. These two contributed £22,367 during the month, and ought, of course, to do better when the difficulties incidental to a start have been overcome. But the Rhodesian department is no place for a boom.

The recent elections show a considerable majority in favour of the continued administration of Rhodesia under the Charter, as against an absorption, in part, by the Union Government. Apparently the company's new policy of development has been well received by the colonists.

News of the trial crushing at the Cam & Motor was belated, and when it came it was conveyed in a cablegram only in part decipherable. From 10,693 tons a recovery of £16,643 was made in bullion, including £800 in slag, to be re-treated. It is estimated that £266 is in solution, and it is stated that leakage of gold solution when starting the plant, coupled with absorption of gold by the plant, serves to explain the low yield, which is equal to about 30s. per ton. The plant was closed-down, for alterations and adjustments, to be re-started on March 11. Better results are anticipated for April.

The quarterly report from the Eldorado is not cheerful, for it shows a reserve of ore only equal to 8 months at the present rate of crushing. Moreover, the average of 13 dwt. gold on the 12th level is a depressing comparison with 23 dwt. on the 9th. However, on the bottom level the orebody is both wider and longer. On the whole, the Eldorado has fulfilled our forecast pitifully.

West Africa.—The February returns of gold output were disappointing, being only 29,929 ounces, valued at £123,169, as against 32,544 ounces, worth £137,038, in the corresponding month of 1913. Indeed, the February production is the lowest since June 1912.

The small rainfall during the recent wet season has caused such a scarcity of water as to cripple alluvial operations at the Nigerian tin mines. Mr. J. W. Iles, of the Rayfield, has advised his company to erect further pumping plant, already on the ground. This lead is likely to be followed by other managers.

The Naraguta, Bauchi, and Rayfield continue to make a steady output of tin concentrate. In six months the Naraguta has varied between 71 and 85 tons of concentrate per month. This is much the most satisfactory mining enterprise in Northern Nigeria. The Naraguta Extended and the Bisichi have shown a sad decline during recent months. As to the latter, we have information that the management, both in London and Nigeria, has left much to be desired. Too much of an eye on the share-market is demoralizing to any administration. The Forum River made a good clean-up in February. The two companies using dredges are still engaged in overcoming technical difficulties.

At the Anglo-Continental meeting, Mr. W. F. Turner, the chairman, stated that the Nigerian government had decided not to increase the export duty on tin from 5 to 7½%, as had been rumoured previously. He also said that the railway was being advanced rapidly, and would reach Bukuru in June.

An engineer on the Ropp leases cabled on March 22: "2000 tons 70% ore Dome river proved dredgable." On this the shares rose one pound, there being 30,000 of them. This cryptic message meant that his testing of the detritus along the Damo river indicated that 2000 tons of tin concentrate, averaging 70% metallic tin, was recoverable by dredging. Nothing is said concerning the quantity of material that is to yield this amount of concentrate, and no mention is made of cost, but it served to give a violent push to the shares, which, presumably, is deemed more important than the winning of tin from gravel. Meanwhile a dividend of 50%, or 10s. per share, has been declared by this company.

Mr. W E. Thomas sends a cheerful report on the West Ropp and Kassa tin area optioned to the Jemaa Exploration Co. This adjoins the Ropp property. He agrees with Mr. Allan Davidson in stating that an extensive deposit of rich ground is assured. Systematic boring has been started.

MEXICO.—The capture of Torreon by Villa and his troops is a severe blow to Huerta, but whether it brings us any nearer a solution of the Mexican tangle remains to be seen. The fighting at Torreon lasted for ten days, and was of the most savage kind, ending in the burning of heaps of dead in the streets of the town. Velasco, commanding the Federal troops, has extricated himself with the remnant of his army, so that he can continue to oppose Villa's advance to the capital. Meanwhile, the general condition of the country is steadily becoming worse.

The Buena Tierra, in Chihuahua, earned a profit in 1913, despite intermittent operation due to rampant brigandage.

The Mexico of El Oro is stated to have absorbed the Oro Nolan, an adjoining property.

AUSTRALASIA. — The Mount Elliott reorganization scheme is finally announced ; a new company with a capital of £400,000 is to be registered to acquire a consolidation of properties. Meanwhile, the smelting will cease at the end of May ; a new plant is to be erected at Cloncurry ; and development of the new properties is to be pushed.

The Hampden Cloncurry company is spending large amounts of money out of profits on shaft-sinking and railway construction. No. 1 shaft has been sunk to 500 feet, where the ore has been found to contain from 5 to 9% copper over the 5-ft. face of the drifts. The full width of the lode has not been determined. The ore at this level consists of almost solid pyrite. The presence of so much basic material is welcome metallurgically. The company reports that the branch railway to the MacGregor group should be completed in four or five months.

The exploration at depth of the Lyell Comstock claims from the 1100-ft. level of the North Mount Lyell mine is being conducted by diamond-drill. The results of the first bore-hole show that ore was cut at 72 feet and that for 39 feet the drill was in ore, averaging from 10 to 17% copper.

A powerful syndicate is said to have taken an option on the Rosebery mine, of the Tasmanian Copper Company, and Mr. G. C. Klug has been engaged to plan the metallurgical campaign. The product of the mine is a silver-lead ore carrying a large admixture of zinc, so that Broken Hill experience should be applicable. Meanwhile the solicitors for the Tasmanian Metals Extraction Co. serve notice that their company has a contract with the Tasmanian Copper Co. for the purchase of the total output of the Rosebery mine ; and for this purpose has erected reduction works involving considerable expenditure.

The Mount Morgan commpany has taken a three months' option on the Laloki, a mine in New Guinea that was bought recently by the Great Fitzroy company. The purchase price is fixed at £75,000 with the right to the Great Fitzroy to call for 25% of the output of matte or ore from the mine at 10% above cost.

The annual report on the Ivanhoe, by the manager, Mr. R. B. Nicolson, indicates the waning energies of this famous mine. During the past year the reserve of ore decreased by 99,433 tons in quantity, and 2s. per ton in assay-value. This decline is attributed to the fact that most of the development work has been confined to the east lode on the lower levels in the porphyry zone, a geologic environment concerning which Mr. Malcolm Maclaren has formed no favourable opinion.

In the Golden Horseshoe the No. 2 lode on the 1884-ft. level proves to be 7 feet wide assaying 15 dwt. per ton. This, added to the good results on the No. 4 lode at 2780 feet, is most encouraging.

The Great Cobar has received its quietus. While the board was making final arrangements for a re-organization, it was suggested that the views of the new manager, Mr. G. C.

Klug, might be ascertained. His reply was decisive. Even with fresh working capital to the extent of £50,000, he could promise a profit of only £25,000 per annum for three years, as against the debenture interest of £40,000 per annum. Mr. Klug reports that the workings have been allowed to become unsafe, so as to require three months' work and an expenditure of £35,000 to put the mine in proper shape. We understand, moreover, that he considers the concentrating plant an abortion, and advises that the silicious ore should be rejected, thereby condemning the entire scheme of smelting hitherto adopted. A receiver (Mr. Arthur F. Whinney) has been appointed. We defer further comment until Mr. Klug's report is published.

CANADA.—Interest in the Kirkland Lake flotations has diminished. The issue of a report on the Tough-Oakes by Mr. Frank C. Loring has not stimulated optimism, because his estimates are considerably below those previously published. Although his report is three months later than that of Mr. H. H. Johnson, he finds only 15,000 tons of a gross value of £190,000. As regards probable ore, not measurable, he refuses to give any estimate; and he is discreet. Comparing this with the £220,000 of Mr. Johnson and the "over £400,000" of the 'management,' we see a shrinkage, due mainly to a cooling of the highly heated atmosphere surrounding a hasty flotation.

The Cobalt consolidation, which was duly chronicled in our last issue, was not received with any pronounced cordiality. The reasons are not far to seek. In the first place, the amalgamating of four companies into one diminishes considerably the number of counters for gambling. In the second place, the shareholders in individual companies are apt to think that their mine is a bit better than any of the three others. We hear that one ground of complaint was the inclusion of the City of Cobalt on the basis of 400,000 shares in the consolidation, whereas the original holding company, the Cossack company, had a nominal capital of only $40,000. That is true, but the Cossack bought its 90% interest in the City for £200,000 cash. The Townsite, City, and Lake properties are officially stated to be looking well, but we regard a decrease of individual earnings as more than probable.

FACE OF THE 200-FT. LEVEL WEST IN TOUGH-OAKES MINE.

As regards the Casey Cobalt, which is not in the consolidation, it is announced that current revenue will be diverted to the eastern portion of the property, fully half a mile from the existing mine, where the Huronian conglomerate has been tested by bore-holes, some of which have yielded cores rich in leaf silver.

Porcupine is developing nicely. We hear that the Acme ground—formerly the Dixon claims—between the Hollinger and the Mc-

Intyre properties, is giving distinct promise. Five shafts are being sunk, and it is understood locally that the ore is of good width and averages over $10 per ton. After the Hollinger and the Dome, the Crown Porcupine, the Thompson, and the McIntyre have the best prospects.

RUSSIA.—Speculation in Russo-Asiatic and Russian Mining shares continues active. So far this part of the business has run far ahead of the exploratory work. At the Ridder the diamond-drill continues to give good results, but 300,000 shares at £8⅜ equals £2,500,000.

The Russian Goldfields, mentioned in connection with the forfeiture of £10,000 in case a further sum of £40,000 is not found, was registered two years ago to acquire the mining rights of Baron Von Breven over a large estate in the Ural mountains, along the river Choosovaya. A dredge was stated to have been put to work, and exploratory operations were planned, but later information is lacking.

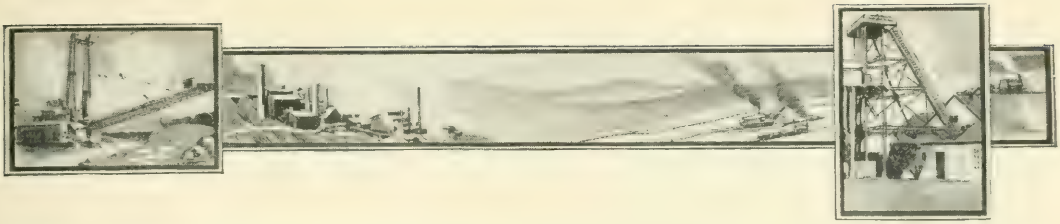
INDIA.—The report of the Ooregum company for 1913 contained encouraging news relating to recent developments, for in three sections of the workings ore of more than average grade is being found in large quantity. On the deepest level, the 51st, south of Oakley's shaft, the lode is 4 feet wide and assays 28 dwt. per ton. In Bullen's section, the ground between the 45th and 46th levels is reported to contain much excellent ore. In Taylor's section the 44th, 46th, and 47th levels are providing ore of satisfactory grade in the shoot south of the dike. The yield of gold for 1913 was the largest in the history of the company, being £360,888 from 153,636 tons.

The Anantapur district has given such encouraging results that the parent company, the Anantapur Gold Field, is issuing £40,000 new capital in preference shares for the purpose of exploring other parts of the seven square miles covered by the concession. Already the company has floated the North Anantapur and Jibutil subsidiaries, and the Ramagiri block has been sufficiently developed to warrant the consideration of the formation of a third subsidiary.

VARIOUS.—In regard to the recent troubles of the Pato dredge, of the Oroville Dredging Co., it is fair to state that Mr. C. H. Munro recognized the fact that while the clay in the overburden presented no unusual difficulty, the bottom clay is "fine grained, stickey, and almost impossible to wash either on a rocker or dredge-screen." In regard to the water-supply, this same engineer warned the company that "the false water-level will have to be maintained with the pumping-plant during the four months dry season." The selected area to which the dredge was directed consists of 92 acres, averaging, according to drill-holes, 40 cents per cubic yard. So far this has been exceeded, but final comparisons cannot yet be made.

The Redjang Lebong, in Sumatra, did not do so well in 1913, the yield being 43,660 oz. gold and 232,894 oz. silver as against 53,040 oz. and 202,016 oz., respectively, in 1912. The bullion output was worth £212,650 as against £251,330 in 1912. An enormous rush of water followed the cutting of the lode on the 6th level last August. This impeded operations for several months. It is evident that an increased supply of power is required to develop the mine deeper. If the results obtained on the 6th and 7th levels are favourable, the plans for augmenting the power-plant will be put into effect. Dividends equal to 15% were paid in 1913 as against 25% in 1912, 50% in 1911, and 90% in 1910. The adjoining mine, the Lebong Simau, paid 20%, as in 1912

The second dredge of the Renong company has been put to work with exemplary promptitude. It started digging on March 23 and is expected to reach productive ground early in April. The other dredge is maintaining a normal output.



EDITORIAL

OUR COMPLIMENTS to the directors of the Village Deep for deciding to charge development expense under 'working costs.' This is another recognition of realities.

SEEING that the consolidations already effected have over taxed the ability of the captains of industry on the Rand, it is unwise to talk of a further agglomeration. Besides, what of Sir Joseph?

LEADVILLE is a name associated with the triumphant application of geology to mining. In this issue we publish a deeply interesting note on the zinc deposits of that district; this is contributed by our friend Mr. Philip Argall, an engineer peculiarly qualified to express an opinion on anything that concerns the geology and mining of Leadville.

KLONDYKE and Klondike represent the Canadian and American spellings of one of the tributaries of the Yukon and of the mining district through which it flows. The varying spelling is an unnecessary nuisance. Proper names are spelled as decided by those to whom they belong. The Klondyke river and district are in Canada; therefore the spelling of the Canadian authorities should be accepted.

COBALT issues are lessened by the consolidation of four important companies, but we regard it eminently proper that these adjacent mines, already under the same control, should be united under one management. Economy of operation and uniformity of output may be achieved thereby, as well as a lessening of those spectacular features incidental to the exploitation of narrow veins of specimen ore. This last feature has always been a weak point, for the profits of the Cobalt group have come from ore deposits essentially erratic, and therefore unsuited for joint-stock finance unless judiciously managed.

IN our January issue we animadverted on the use of 'orey' by Mr. A. C. Spencer of the U.S. Geological Survey. It is only fair to say that he is sustained by Murray, the Standard, and the Century dictionaries. We do not like the word any better for its sponsors, but we acknowledge that Mr. Spencer is amply justified in his use of it.

WE NOTE with pleasure that Mr. G. G. S. Lindsey has been elected president of the Canadian Mining Institute. A good speaker, a charming personality, a man of public spirit, keenly interested and actively participating in Canadian mining affairs, he will make an excellent president. He succeeds one of the leading geologists of the other side, Mr. A. E. Barlow, a scientific investigator of the first rank. So long as the Canadian Institute can select such worthy representatives of science and industry, it will continue to prosper. Nor do we forget Mr. H. Mortimer-Lamb, to whom, as an energetic and devoted secretary, the Institute owes so much, and others for whom he has been willing to spend himself generously.

THE ARTICLES on the volatilization process for gold ores, as described by Mr. Ben Howe in our December issue and subsequently by Mr. Stuart Croasdale in our March issue, afford a good example of the kind of technical contributions for which the profession may feel truly grateful. Both Mr. Howe and Mr. Croasdale recounted their difficulties and failures, no less than such successes as they were able to win in the course of their valuable experiments. We like particularly the frank and friendly pose of these two workers toward each other's research. This Magazine, or any other professional periodical, is never put to better use than in placing on record the obstacles obstructing metallurgical development, for by recognizing them and avoiding them the way is made easier for those that follow. The fortuitous success is easy to claim, but the honest failure containing the seed of metallurgical promise is likely to be more instructive and helpful.

REFERRING TO the discussion on the term 'ore,' we note the suggestion made by one honoured contributor, that such matters of definition should be left to professional societies like our Institution in London or the Institute in New York. To this we demur without hesitation. The last formal discussion of the subject before the Institution of Mining and Metallurgy indicated that, as Mr. Trewartha-James says, "many prominent members of the profession were satisfied with the vague and indefinite usage of the term, showing a deplorable lack of appreciation of the necessity for precision in technical terms, especially in those so commonly and frequently used." To speak with complete frankness, we submit that no reason exists for believing that either the organization in London or that in New York is peculiarly fitted to do dictionary work. In the end, any result would be traceable to some individual whose writing would probably require editing before publication in any technical journal of approved standing. In other words, the idea that a committee of engineers or geologists would be less fallible than any one of their number is absurd. Collectively, they would, we think, be less successful than the most intelligent individual among them. We go further. "Use is the law of language." We are speaking of the language of technology, and of the printed word, which outspeeds, outranges, and outlives the spoken word. Who uses it most? The mining engineer or the editor? The geologist or the journalist? Speaking for the fourth estate, we submit to our indulgent readers that the technical press is the logical authority in these matters, if aided by a frank expression of the views of its readers, as has been the case in the discussion under review. We trust it has served a useful purpose.

COMMENTING on Mr. James Douglas's useful advice to mining students, we referred to instruction in writing reports. In our last issue Mr. Harry D. Wolf wrote concerning the lectures on 'Mine Examinations and Reports' given at the Colorado School of Mines. We intended to have drawn attention to this letter last month, but it is not too late to do so now, for the departure from conventional instruction is well worthy of explicit approbation. We know that Mr. Victor Alderson, lately the president of the Colorado School of Mines, was keenly interested in the teaching of the proper use of our language, and stimulated his students to an intelligent interest in technical phraseology. Of course, we are heartily in sympathy with such efforts to clarify the medium of thought employed by engineers, and appreciate the great help to a young engineer of the ability to make efficient use of the tools of verbal expression. The Colorado School of Mines in this respect sets an excellent example.

WE ARE much obliged to Mr. E. E. McCarthy, the dredge superintendent of the Yukon Gold Company, at Dawson, for his valuable contribution on the stripping of frozen gravel. Our own articles appeared in the issues of September, November, and December 1912. The later information afforded by Mr. McCarthy has great technical value as coming from one who has directed and supervised such operations for many years. He demurs strongly to the estimates and anticipations submitted by the engineers and promoters of the North West Corporation and the Granville Mining Company. In our issue of January we suggested that the cost of 'treatment,' assuming it meant the exploitation of the frozen alluvial deposits, was so low as to require technical explanation. A reply from so experienced a pioneer as Mr. J. W. Boyle would be timely, for he will not have committed himself to the official forecast without having good reasons.

IT BEING CUSTOMARY to choose a new president for the Institution almost as soon as the one last selected has taken the chair, we venture to refer to the matter at this early date. The presidency just concluded has been so satisfactory from every point of view that a general feeling of complacency among members of the Institution is not unreasonable. But it is not justified by the real facts. The demands made upon the time and energy of the president are such that the few men eligible for the distinction are disinclined to accept it. If once the natural leaders of the profession step aside and allow the titular headship to pass to those less obviously fitted, then the prestige of the position and, with it, that of the Institution will suffer severely. Each member of the profession owes something to it, and if that something takes the concrete form of giving a large part of one year to the service of his professional organization, he ought not to grudge it. Out of those eligible, there are three men having such a standing in the City at the present time that the nomination of any one of them to the presidency would be highly appreciated, both within and without the Institution. When any one of these is asked to serve, we beg him on behalf of the rank and file of the profession not to allow private business to push aside a public duty. His compensation comes to him an hundred-fold, in honour, goodwill, and the sense of a duty well done. As Bacon said: "I hold every man a debtor to his profession." It is a debt that a man of high character will try his utmost to pay.

THE MARCH meeting of the Institution marked the transfer of titular leadership from Mr. Bedford McNeill to Dr. F. H. Hatch. The tributes paid to the outgoing president were of a warmth and sincerity not usual on such occasions. Indeed, Mr. McNeill, on his retirement from the chair, takes with him the glowing goodwill of the members of the Institution. He has the satisfaction of knowing that he was at the helm during a memorable year, and that his sagacious hand on the tiller has brought the Institution visibly nearer a secure anchorage. As a presiding officer, he has fulfilled the expectations of his friends, and as a maker of humorously instructive speeches, he has delighted everybody. Such obvious qualifications have given charm to his presidency, although they were only an adornment upon his earnest devotion to the multifarious duties of the position. He has enhanced the traditions of the office and set an example difficult to follow. We unite with all our readers in the hope that he may live long and prosper.

Geologists and Engineers.

Presidential addresses are not exposed to ordinary discussion; they are ex cathedra utterances of a pontifical character intended to link the changing occupant of the chair with a larger view of things in general. Hence the incoming president of a professional society customarily uses the opportunity to review the development of that branch of knowledge in which he has won honourable prominence. Dr. Hatch fittingly chose the relation of geology to mining as a text for his presidential address before the Institution. He held his audience well throughout a scholarly and comprehensive summary of the growth of economic geology. What he said made no particular claim to novelty, but it served as a timely and proper reminder of the important aid given today by a young science to an ancient industry. Indeed, the economic geologist has come into his own. Dr. Hatch himself is the first geologist to be president of the Institution, and we hope that his year of office may be signalized by the discussion of many of the technical problems involved in the origin and classification of ore deposits. We do not propose to criticize his presentation of the technical aspects of his subject, but we find provocation in his description of the functions of a mining geologist. This part of his address is controversial. According to our new President the mining geologist takes all of mining that the mechanical engineer surrenders. He is to direct mineral exploration, to indicate the method of mining, to sample mines for valuation, and to suggest the proper metallurgical treatment. We are glad to see, however, that as a preliminary for such all-round capacity he is to undergo an apprenticeship in mine management and mine examination. But it will not do. Dr. Hatch's classification of ore deposits may be acceptable, but his classification of professional men certainly is not. He is describing an accomplished mining engineer, not a mining geologist. The latter is a specialist, not a general practitioner, and no good can come by confusing one with the other. The province of the mining geologist is to find ore and to explain why he can't find it. The province of the mining engineer is to extract it at a maximum profit or a minimum loss, as circumstances permit. We disagree altogether with the suggestion that whether a man is called a mining engineer or a mining geologist is of no moment. *Ne sutor supra crepidam*. As the learned President himself said: *Verbum sat sapienti*. No; we are sure that the growing recognition of the value of the economic geologist is likely to suffer by a misunderstanding of his particular scope and utility. A mining engineer is a man who conducts mining operations; in order to do that intelligently he needs occasionally to ask the geological specialist to give him some ideas concerning the structure of the lode and the distribution of the orebodies, but that does not mean that he desires the geologist to advise him on other matters. To do that is the best way to render economic geology ridiculous—which is the last thing the President of the Institution would wish to do. We have fought for the proper recognition of geology as applied to mining for many years, and we rejoice to see that the young science has won its spurs in England. It achieved an assured position in America long ago. We note also with keen pleasure the fact that several of our own countrymen have won honour as mining geologists in the English-speaking world, but we insist that only harm can come from the idea that the mining geologist is interchangeable with the mining engineer. The art of mining requires the aid of many sciences, and geology is one of the chief, but the suggestion that it is within the province of the geologist to value mines or to advise on the metallurgical treatment of the ore is humorous. The millman might return the compliment and label the geologist's fossils for him or the cyanider might undertake to simplify his stratigraphy. There is work enough for all. Let each do that for which he is equipped. *Chacun son metier et les vaches seront bien gardées*.

Broken Hill.

In spite of its thirty years of productiveness, the Broken Hill ore deposit continues to provide pleasant surprises. We have referred previously to discoveries in the British mine and in the South Blocks. More recently developments in the North and South mines have called attention to the possibilities both in depth and laterally at the two ends of the Broken Hill ore-channel. At the North mine the shaft has been sunk to 1400 feet, and a cross-cut driven to intersect the lode at 360 feet. At this point a drill-hole has proved the lode to be 112 feet wide, the core assaying 17·5% lead, 15% zinc, and 10 oz. silver per ton. At a point 150 feet short of the lode, two other bore-holes have been drilled, estimated to cut the lode at 100 and 200 feet respectively south of the cross-cut. The first has intersected 122 ft. of ore, assaying 16·2% lead, 14·8% zinc, and 10·9 oz. silver; while at the point where the second drill-hole crossed the lode the width is 110 ft. wide, assaying 16% lead, 11% zinc, and 10 oz. silver. These results indicate that the lode is wider than on the 1250-ft. level, and contains ore slightly richer than any now being mined. The 1250-ft. level was by far the best hitherto opened both as regards extent and content. It is a truism to say that the reliability of an estimate of probable ore based on bore-holes depends on the past history of a mine and the character and special experience of the engineer making the appraisal. In this case, Mr. George Weir deduces that the reserve has been increased by 1,300,000 tons. As he has had every opportunity of studying the behaviour in depth of the two main orebodies, we may take it that his estimate is reasonable. The gradual but substantial increase of the assay-values in lead and silver as the orebodies have been followed downward is worthy of note; during the last half-year the ore extracted from the 500-ft. level has averaged 12·8% lead and 3·1 oz. silver; from the 800-ft. level 14·8% lead and 4·1 oz. silver; from the 950-ft. level 15·6% lead and 5·5 oz. silver; and on the 1250-ft. level 16% lead and 8 oz. silver. The zinc content has been fairly constant, varying between 12 and 14%. The developments in the South mine are of equal importance, but Mr. W. E. Wainwright is more cautious in the matter of estimating ore on the results of bore-holes, for he has to deal with a new parallel lode of unknown character. For many years there appears to have been a theory that the orebody worked in the South mine would pitch southward more steeply than it does in the Block 10 and Central leases to the north, and that the southern ground would be barren. Recent development in the South Blocks mine, belonging to the Zinc Corporation, adjoining on the south, has suggested a modification of this theory, now fully disproved by active development of this area. Bore-holes have been drilled westward on the 970-ft. and 1070-ft. levels, and, at distances of about 400 feet west from the main lode, the drills cut into ore of excellent grade. The assays of the various bores vary more than those in the North mine, but it is obvious that a find of great importance has been made. Whether this new orebody is connected with the parallel lode in the Central mine and Block 10 remains to be seen.

We note with interest that the North mine has made a new departure by accumulating a reserve of ore on the surface. In Australia the tendency among the miners is to have idle days frequently, for one reason or another. As the concentrating plants run at their best when operated continuously, and in order to keep the output of concentrate to a maximum, it has been deemed desirable to maintain a substantial reserve of ore on the surface to bridge the periods when stoping is suspended. The North and South companies are embarking on the treatment of slime by means of the selective method of flotation under licence from the Minerals Separation company. At the South mine the Owen process has been adopted. In this process, as recorded in these columns recently, the galena is floated first without acid and the blende subsequently raised by the ordinary Minerals Separation method. The plant will have a capacity of 500 tons per week, to be increased afterward to 2000 tons, half to be devoted to current production and half to the treatment of old slime. With lead at £15 per ton it is calculated that this treatment will leave a profit of £1 per ton of slime. The company has an accumulation of approximately 350,000 tons of this material averaging 11·2% lead, 14·2% zinc, and 5·9 oz. silver. Details of the plant to be erected at the North mine have not been settled, as the relative advantages of the Lyster and Owen processes as applied to the ore are still being investigated.

Another topic of discussion at Broken Hill is the proposed sale by the Proprietary company of the Port Pirie smelting works to a new organization, by means of which a part-ownership of the smelter will be acquired by the North and South companies. The benefit of such an arrangement to them is not clear. The logical supposition is that the Proprietary, not having been successful in raising the whole of the new capital required for the iron and steel venture, has had to devise other means for raising the necessary funds. This could be done by selling a large interest in the Port Pirie smelter to its two prosperous neighbours. But these two companies do not appear to be particularly keen, and the proposals may come to nothing. The North and South mines in the past have sold their lead concentrate in Germany, except during the years 1910 to 1912, when the Proprietary made more advantageous bids, prompted by a desire to keep the works at Port Pirie going while its own mine was not contributing. The Proprietary is the only Broken Hill company that has from the commencement retained the treatment of tailing in its own hands. About a quarter of its zinc concentrate is reduced in its own distilling furnaces, the remainder being sold to German buyers. The Amalgamated Zinc (De Bavay's) company produces zinc concentrate from the North and South tailings, and similarly sells it to Germany. The fact is that zinc-distillation has proved to be an industry not suited to labour conditions in Australia. At the furnaces, as in mining, operations are interrupted from time to time, and of all metallurgical processes that require continuous and close attention this is an easy first. The operation is more satisfactorily conducted in a country like Belgium or Germany, in old communities, well disciplined and alive to the responsibilities of faithful labour. It will be seen from our remarks that the general conditions at Broken Hill point to the North and South compensating for the decreases at other mines where the reserves are now showing signs of depletion; while, on the other hand, the output of metals will be substantially increased by the establishment of plants for beneficiating slime, a product obtaining increasing economic value as the flotation processes become developed and differentiated.

The Institution.

The annual dinner of the Institution of Mining and Metallurgy on March 12 was, as is usual, an interesting affair. The attendance was large and representative. As was expected, the dominant note was struck by a reference to the charter, first by the Marquis of Crewe, who said that he would do what he could to assist in any way in setting forward the claims "of this great Institution." Shortly afterward the President, Mr. Bedford McNeill, was able to announce at the end of his speech that the petition for a charter was then before the Privy Council. Naturally Lord Crewe's promise of friendly assistance was highly appreciated, and the President's statement as to the progress of the application was heartily cheered. At least as interesting was the President's statement that "the grant of a charter will enable us to still further elevate our profession, and more effectively insist, not only upon a high standard of practical and scientific proficiency, but also on the observance of strict rules with regard to professional conduct." This is well said. We hope it may prove to be not only a pious hope but an accurate prophecy.

Another subject to which reference was made by several speakers was the Royal Commission on University Teaching in London, more particularly in its bearing upon the Imperial College of Science and Technology. Lord Crewe, as a Secretary of State and as chairman of the Governing Body of the Imperial College, was, of course, in a position to speak on this subject with authority and sympathy. "What should be the nature of the link" he asked "uniting the Imperial College to any reformed London University? Are we to be absorbed in a kind of Buddhist Nirvana?" The laughter greeting this apposite simile was followed by loud applause when he expressed his preference for a separate Technological University, Imperial in character but distinct from the conventional centres of academic learning. The only blemish on this utterance and on others referring to the same subject was the omission to refer to the Royal School of Mines as a constituent part—and to mining engineers the most interesting part—of the Imperial College. It is true the venerable geologist, Sir Archibald Geikie, made a feeling reference to De la Beche as the founder of "a School of Mines in Jermyn street which was the germ of the Imperial College," but this did not correct the omission to which we have referred. However, this may seem a matter of minor importance to many of our readers, who, if present, would soon have ignored the omission in their delight to hear Mr. McNeill deliver a characteristic speech, in replying, as President, to the toast of the evening. He had delved into Humboldt and Xenophon, he had ransacked the chronicles of a much later time, to enrich his speech with illustrations of the humaner aspects of the mining industry and the more humorous phases of the miner's relations to society. It was well done and well delivered, evoking frequent laughter and sustained interest. Mr. J. H. Cordner-James, one of our most effective speakers, proposed the toast of 'The Guests' in felicitous terms, drawing replies from Sir Archibald Geikie and Sir Thomas Elliott. The latter, who is Deputy-Master of the Mint, posed as the poor relation of the mining engineer, and made a speech scintillating with wit of a most provocative kind. "I wonder where the profits of the Mint would be if we had to pay as much for silver as we get for it." The chairman's health was proposed by Lord Joicey, the toast being received with great enthusiasm culminating in musical honours. Then came a final, and most graceful, episode. The President rose to express his thanks for the aid given to him during his year of office by the Secretary. Mr. Charles McDermid well deserves the public recognition thus accorded for his devotion to the duties of his department. And so ended a memorable evening.

Petroleum in South Africa.

For some years search for petroleum has been conducted in several parts of South Africa, with consistently disappointing results. Throughout the Karroo beds in the Cape Province traces of petroleum and allied products have been found associated with, and in the neighbourhood of, dolerite dikes and sills. Much drilling has been done in various places, and occasionally to great depth, but nothing more than so-called indications have been detected. In Natal and the eastern Transvaal, oil-shale has been found in the coal measures, the formation being analogous to that in south Scotland. What was supposed to be natural gas has been the basis of investigations, but in many cases the diagnosis has been founded on erroneous suppositions. There gradually arose a general impression that the prospectors and engineers were working in the dark, and that a geologist with experience in connection with petroleum occurrences should be asked to investigate South African conditions and formulate suggestions for further work. Accordingly the Union government invited Mr. E. H. Cunningham Craig to visit the chief centres of operation. He spent three months, toward the end of 1913, covering 3000 miles during this time. He had the assistance of the staff of the Geological Survey, a welcome help in studying the stratigraphical relations. His report now published is in form and character admirably adapted to the requirements of the case. He starts with a general dissertation on indications. He shows that in many cases, including the alleged petroleum field at Ceres, in the Cape Province, emanations of marsh gas have been mistaken for natural gas, and that in other cases the iridescent film of ferric hydroxide on the surface of swamps has led prospectors astray. With regard to the petroleum and allied compounds in association with dolerite dikes and sills in the Karroo beds, he shows that these carbonaceous substances have been formed by the passage of the intrusive rock through coal seams and oil-shales. At no place, except in a line east and west through the centre of the Cape Province, where a fold in the Karroo beds occurs, does the geological structure contain the anticlines and domes so often associated with petroleum accumulations. Mr. Craig is not hopeful, however, of favourable results following boring in the region of this fold. The possibility of petroleum being found in the neighbourhood of saltpans is also adversely discussed, for he shows that they are the accumulations during geologic ages of the denudation of a country continuously above the sea, and that in many cases fresh water can be obtained from wells in their vicinity. Thus the salt has no connection with the brine and rock-salt so often found in conjunction with petroleum. Mr. Craig proceeds to describe the oil-shale in the Ermelo district, in the eastern Transvaal, and in the Drakensberg range, in Natal. Owing to the thinness of the seams at Ermelo, none being much over a foot wide, it would be impossible to mine them at a profit. On the other hand, the Natal deposits are more hopeful, and he recommends that they should be tested on a large scale. As to natural gas, he is of opinion that in many places accumulations would be found under dolerite sills, that might afford small local supplies for lighting purposes. Altogether Mr. Craig's report is depressing reading to those who had hopes for the foundation of an important industry ; it is, however, a report of wide-reaching importance and value, and will always be quoted as an authoritative statement.

The R.S.M. Dinner.

When the alumni of the Royal School of Mines foregathered in annual dinner on March 18 it was to mark a new departure. This was the 41st Old Students' dinner, but the first of the new Association ; in other words, having dined together for 40 years the men of the School of Mines had finally organized themselves with the serious purpose of defending their Alma Mater from the perils incidental to the educational flux at South Kensington, and also of helping one another, more particularly young and necessitous students on the threshold of a professional career. The annual gastronomic exercises no longer sufficed to express their loyalty to the School ; the three cheers for the R.S.M. had ceased to measure the extent of their financial support. The Association formed only eight months ago, shortly after the dinner of 1913, and in consequence of the suggestion then ventilated, had come into effective existence with a membership of 220 and a sum of £661 in the bank. Of course, the 220 does not indicate the possibilities of membership, for many of the old students in distant corners of the earth have not yet heard of the formation of the Association, or are still awaiting further particulars concerning it ; but enough has been done to prove that there is a body of stalwarts willing to spend and be spent in behalf of the place of their professional origin—a place that needs no apology. It is pleasant to find that the outside world is of this opinion also. In his speech, proposing the toast of the evening, Mr. F. H. Hamilton gave his testimony in terms that must have warmed the hearts of those present. It was, we think, a happy idea to ask an employer of engineers to propose this toast, and, we venture to say, it was a particularly happy idea to invite Mr. Hamilton to propose it. His speech was delightful in matter and in manner. It is something for a leading financier to say that, in consequence of his business association with Royal School of Mines men, his attitude toward the school "is characterized by a sense of obligation and gratitude." And the sincerity of this statement will not be questioned when we mention that his principal engineer is Edward T. McCarthy, A.R.S.M. Indeed, Mr. Hamilton paid a fine tribute to the second vice-president of the Association—a tribute that was received with unmistakable cordiality by the entire gathering. Passing to the influence of the Royal School of Mines in creating a healthy public opinion in mining affairs, by means of the character of its graduates, Mr. Hamilton testified his belief that there is a decided improvement in the code of conduct controlling the business of mining, due to the force of public opinion within the profession itself. He even ventured to say that this public opinion within the profession is "becoming crystallized into a standard of conduct and honour as high as that which obtains in any profession." We quote this with keen delight. It is true, the speaker said he was an optimist; so are we; so are all who have ideals that are worth while. Then picking up a reference made to Huxley by an earlier speaker, Mr. Hamilton struck one of the truest notes ever sounded at a Royal School of Mines dinner. Referring to the greatest scientific philosopher of our times, he dwelt upon the fact that whatever else he taught he was supremely qualified to teach the lesson of intellectual honesty. "That, gentlemen, was the lesson Huxley taught—a lesson that is to-day one of the spiritual inheritances of the Royal School of Mines." Indeed, it is. The essential manliness, the intellectual honesty, and the moral courage of the gloriously belligerent dialectician of the Victorian epoch constitute a tradition that warrants the prefix of Royal. The Prince Consort gave it the prefix; Thomas Henry Huxley gave it a "spiritual inheritance."

This speech was answered by the chairman, Professor Gowland, who is also the president of the Association. He gave an account of the successful starting of this organization, and then proceeded to make an earnest protest, which was heartily applauded, against the absorption of the School of Mines in the London University agglomeration. We give the text of this speech on another page.

Then came a new feature. In order to promote comradeship between the present students and the older graduates, the executive committee of the Association invited the fourth-year students to come as guests to the annual dinner—not all those doing the 4th year courses, but such as had passed their examinations and were likely to obtain their degree this year. These, to the number of 25, were seated alternately with their hosts at the chief table. It was arranged, by the Hon. Secretary, that a number of short speeches should be made by some of the engineers with a view to interesting their young guests. Hence it was suggested that the speeches might convey a lesson or a hint, served in humorous guise. Messrs. T. C. Cloud, Ben Howe, E. T. McCarthy, and T. K. Rose spoke, with graceful replies by two students, Messrs. J. C. Allan and E. F. Newall. This part of the function was a great success. Mr. Ben Howe made an intensely funny speech, ending in an appropriately serious note; the celebrated Chemist of the Mint conveyed a couple of good lessons most humorously; while Messrs. Cloud and McCarthy spoke in serious vein throughout. But we are much mistaken if the students were not particularly grateful to them for their 'heart to heart' talk. Then came the toast of 'The Chairman,' proposed in genial terms by Mr. A. G. Charleton. This was received enthusiastically and with musical honours. Finally, the vigorous singing of Auld Lang Syne gave outward and visible sign that the men of the Royal School of Mines have traditions, associations, and aspirations that they will not willingly let die.

Blackmail.

The *Rubber and Oil* blackmailing episode, which ended in the conviction of Edward Beall and James Merchant, may convey a salutary warning to the other buzzards of journalism that batten on corrupt finance. It is unpleasant to see the cowardly attacks made by ex-convicts and undischarged bankrupts described as 'journalism,' but it is equally nauseating to see eminently respectable newspapers admitting the piffle of clerks in the big department stores as reading matter prepared in the 'editorial' rooms of Selfish & Co. or Horrors, Ltd. It is true the verbal rubbish thus provided is advertising matter, but even in this guise it is a nasty blot on real journalism. From the brigandage of *Rubber and Oil* there is every gradation to the insincerities of a Special Commissioner's report in the *Greenminster Gazette* under cover of which what the Americans call a 'dry-goods store' is enabled to hide a blatant advertisement under the cloak of genuine reporting. Journalism will never break away from the taint of corruption until not an inch of space in the reading pages is purchasable, and not an inch of space in the advertising pages is gratuitous. As to *Rubber and Oil* and its miserable campaigns of slander, we became aware of this member of the gutter press when, in making a criticism on a mining promoter and engineer, we were threatened with legal proceedings that came to nothing. At that time the blackmailers operating under cover of *Rubber and Oil* asked us to give them information whereby they could join in the hue and cry. That was the worst insult ever passed on *The Mining Magazine*. We were not camping on any man's trail, and having made our criticism once, effectively, we had no desire to pursue either the subject or the individual chiefly concerned. We agree with Mr. Justice Darling that the people who set traps for Beall and Merchant and thereby succeeded in having them removed from active life did "a great public service." We believe, however, that bribe-taking would be impossible except for bribe-giving; in other words, that blackmail is the logical consequence of the attempt to silence the press by sops. From *Rubber and Oil* to journals of unctuous rectitude there is no great gulf fixed; the reading notice is a pseudo-respectable concession that begins to sap the independence of the editor; the fee for quoting share-prices is a step toward payments of a coarser kind; the acceptance of objectionable prospectuses in papers that preach financial morality implies the obligation to observe intervals of discreet silence. Another feature of the recent episode is the indication that so-called investors are excessively timid, largely because they are told so little about the conditions governing the success of their 'investment' that they are frightened by the first whisper of suspicion, even when it comes from a disreputable source. For this there is an obvious corrective, and that is to give information to the shareholders, frankly and fairly. Sound enterprises efficiently managed can afford to laugh at the blackmailer; weak undertakings launched by persons themselves contemplating a predatory campaign are bound to be vulnerable. Light and fresh air kill the germs that infect alike piratic journalism and predatory finance.

Ore.

In our November issue Mr. E. T. McCarthy suggested the need for a new definition of the technical term 'ore,' and started a discussion on the subject by submitting a definition himself. In subsequent issues we have been enabled to publish the views of Messrs. F. H. Hatch, Stephen J. Lett, W. F. A. Thomae, G. Percy Ashmore, Howard D. Smith, A. G. Charleton, S. J. Truscott, A. H. Heath, Edward Halse, Hugh F. Marriott, William Frecheville, H. S. Denny, James F. Kemp, W. H. Trewartha-James, Thomas T. Read, C. S. Herzig, G. S. Duncan, H. R. Sleeman, and William McDonald. Thus 20 pronouncements have been made, and by men able to see the problem from many points of view. The miner and the geologist, the professor and the practitioner, alike have contributed ideas on which to build a reasonable conclusion. At the start we must set aside the various definitions that do *not* define; it is useless to imitate Sydney Smith and describe an archdeacon as "a person performing archidiaconal functions." That leads nowhere. Either we must crystallize the essential meaning of the term under dispute or leave it to be mauled, mangled, and mishandled without further protest. As now used in metal mining it means nothing except the supposedly metal-bearing rock that is the objective of exploitation. As thus employed it is not a term of precision, but because it generally connotes some idea of value it is applied carelessly to material that cannot be exploited profitably but can be used as the stock-in-trade of financial operations and share speculations. Because of the failure to define, we set aside the majority of the definitions submitted. These describe 'mineral,' not 'ore.' For instance, Mr. Edward Halse, a recognized authority on technological nomenclature, says that "galena is an ore of lead wherever and whenever it occurs." No; if we disregard the economic aspect, galena is only a mineral of lead. Mr. McCarthy would include sea-water, as a source of salt, but would exclude iron ochre, which from time immemorial has been applied to the use of man without "undergoing some kind of treatment whereby it is entirely changed chemically or physically." Some of the earlier contributors protested promptly against the enlarged application of 'ore' so as to include coal, phosphate, or limestone. With that objection we are in entire agreement. The idea of metalliferous is implicit; nay more, the heavy metals used in the arts are kept in mind by most people using the term 'ore.' Any definition based on the idea of all mineral aggregates containing any element of commercial value fails utterly in being too embracing; a definition must be restrictive if it is to be precise. If it is not precise, we have no use for it in technical literature.

Let us examine some elementary considerations. A piece of malachite lies on a table. To the ordinary man only its green velvety beauty is significant; to him it is a semi-precious stone. To the mineralogist it is a specimen of a not uncommon mineral. To the chemist it is a carbonate of copper. To the miner it is all of these; and it may be more. To ascertain whether it is more than an exceptional specimen of a common mineral, the miner asks: How much of it is there? If it is a mere fragment or sample of a large body of similar material, he looks upon it as 'ore,' that is, something that may be the means of profitable exploitation. If he learns that it is a piece that came from a mineral collection or represents an exceptional spot in a rock not exploitable as a source of copper, then he does not call it 'ore.' He calls it a piece of malachite. We demur to Mr. Read's report of an imaginary conversation in which a geologist, visiting a mine, asks "What is that?" He is told it is "lead ore." Later he is told that something else looking much the same is "waste." If he asked the first question he would—or should—have been told that it was a 'lead mineral' or 'galena.' Secondly, as a geologist, pure and simple, he would be entirely incapable of passing upon the economic value of the mineral deposit. Even the superciliously clever mining engineer who would label one piece of mineral 'ore' and another piece 'waste,' under the circumstances related, would not be a person of any consequence in our present argument. But Mr. Read makes several good suggestions, as, for example, that we distinguish between the present generally accepted meaning of 'ore' and the desirable restricted meaning for which we are striving. He himself grants that the idea of yielding a profit is "inextricably bound" with the idea of composition. He despairs of any definition, and suggests the invention of a new term. Mr. Trewartha-James doubts if engineers use the term "in the strict sense" of our own definition, which we may as well quote here. "Ore is metal-bearing rock that, at a given time and place, can be exploited at a profit." The same studious contributor referring to the looseness of usage, calls 'ore' a "kaleidoscopic term." As used in the financial Press, it is. While we appreciate the interest of scholarly references to ancient literature—meaning thereby in technology anything more than ten years old—we submit that what 'ore' may have meant in the past is only of academic interest; we are trying to formulate a definition consonant with its meaning in the vivid present, not the gouty past. As Mr. McDonald suggests, we must use terms that can be understood by those engaged in mining. We agree with Mr. Herzig that the definition is to be made in the interest of the miner, primarily, and not that of his assistants, the geologist and the metallurgist. The miner envisages the whole operation of mining, the others a part of it only. That is why we cannot accept Professor Kemp's well known definition, quoted by Mr. Herzig in his recent book on 'Mine Sampling and Valuing.' The Columbia professor says that 'ore' in its technical sense is "a metalliferous mineral or an aggregate of metalliferous minerals . . . capable of being, from the standpoint of the miner, won at a profit, or from the standpoint of the metallurgist, treated at a profit." We submit that the miner would be a most improvident person if he only paid heed to the cost of stoping, tramming, and hoisting, disregarding the necessary expense of metallurgical treatment. On the other hand, the expectation of a metallurgist that he could treat a given material profitably would afford no adequate economic basis, for the cost of metallurgical treatment might be, and usually is, a minor portion of the total cost. When an intelligent miner looks at "an aggregate of minerals" he considers carefully whether he can extract from it metal having a value more than sufficient to pay the cost of development, breaking, tramming, hoisting, milling, and realization, besides sundry other items of more than academic importance. If he does not consider these items, he is not intelligent, and he ceases to interest us. Professor Kemp acknowledges that the idea of profit does enter. He refers to 'pay-ore' and 'commercial ore,' both of which, we submit, lay stress on this dominant factor. 'Pay-ore' is merely an emphatic form of 'ore.' Professor Frecheville states that "the use of the term implies that the contained metal is present in a proportion or percentage that has been treated successfully elsewhere." Professor Truscott quotes a recognized German authority, by whom the idea of profit is recognized, but he himself rejects that qualification and asserts that metalliferous material is ore before it has been demonstrated whether it is profitable or not. Then the water of the ocean is ore because it contains gold, for example, not to mention other metals. With the purely academic uses of the word the mining engineer is not concerned; it is an industrial term. The geologist has his 'rock,' the mineralogist his 'mineral,' the chemist his 'element' and its compounds; the miner and the mining engineer are engaged in an industry, not a scientific pursuit. To them profit is of the essence of their operations. Three gentlemen accept this idea as a limiting factor and we are pleased to recognize in them three engineers closely in touch with the realities of mining. Mr. Herzig also grants that mining is done with a view to profit, but he points to the difficulty of defining 'profit.' That also is a term we have tried to clarify. Most of these basic terms hang on one another; until the members of the mining profession learn to use them intelligently, such words as 'ore,' 'cost,' and 'profit' will be verbal quicksands in which they will flounder, greatly to their loss of dignity, and trustworthiness, as viewed by their clients. Mr. Herzig submits several problems, all for the elucidation of the matter in hand. We take pleasure in meeting him in the same spirit. As to the lead concentrate and zinc concentrate at Broken Hill, we reply that the idea of profit is not linked to 'concentrate.' A concentrate is the product of concentration, a metallurgical operation whereby the valuable contents of an ore are brought together in a product of reduced bulk.

Case No. 1, as submitted by Mr. Herzig, assumes an engineer viewing "a mineral deposit" in a locality where he is unable "to determine all the economic factors." He makes a tentative valuation based upon hypothetical factors. Mr. Herzig asks how is he to describe "the mineral mass?" In this case he can do no better than employ the terms used in the question. It is—to him—a 'mineral deposit,' or a 'mass of mineral,' or a 'mineral aggregate,' until such time as he knows something definite concerning the yield of metal to be derived therefrom and the cost incurred in obtaining that yield.

Case No. 2 refers to a low-grade copper deposit that may prove profitable with the metal at £60 but may entail loss with a price of £50. This is what Mr. Herzig means. Is the engineer supposed to follow the metal market? He may be in a remote locality and be unaware of an adverse turn in the price of copper. If the deposit is 'ore' at £60, what is it at £50? To this we reply that, of course, the engineer must have a correct notion of the market-value of his metallic product; if he does not, he had better stay at home, for he lacks the first requisite for an appraisal of the mine. The knowledge of these and other things not taught in text-books constitutes the chief difference between the mining student and the experienced engineer. If he lives in a remote locality and does not follow the trend of the copper market, his report concerning the quality of his mineral output should be supplemented by a further report at the hand of somebody nearer the business centre. If he is temporarily in a remote locality, that need not matter, as his estimate of the price of copper is based on averages, not passing fluctuations. And what is he to call this mineral aggregate having possible commercial value by reason of its copper contents? He can call it a copper 'lode,' 'vein,' or 'deposit.' He can call it copper 'ore' under a favourable market and copper 'mineral' under adverse conditions. 'Mineral' is a scientific and a legal term divorced from the immediate idea of profit, for neither science nor law is concerned with the main purpose of mining. 'Mineral,' of course, includes the idea of an aggregate of minerals.

Case No. 3 refers to a big body of complex ore in Burma and to another in Tasmania, in both cases the silver, lead, zinc, and copper being so intimately mixed as to constitute an extremely refractory product. The metallurgical problem has not yet been, but may soon be, solved; how is this stuff to be labelled meanwhile? We would speak of the 'complex sulphides,' the 'refractory mineral'; or 'the sulphides,' 'the mineral,' because the lode contains matter of which the chemist and the mineralogist may speak with assurance, but the miner with timidity until his junior partner, the metallurgist, has told him how it may be beneficiated profitably.

Case No. 4 deals with the Mount Lyell and North Mount Lyell mines, one having large bodies of low-grade basic material, and the other equally large bodies of silicious copper mineral. Alone neither can be exploited to advantage; by mingling their mineral products a successful smelting mixture is effected. Which is the 'ore' and which is the 'flux'? The one that contributes the main proportion of the valuable metallic product is the 'ore.' Both may produce 'ore' if the operation of both mines yields copper more than sufficient to meet the cost of individual exploitation. Two 'ores' may flux one another. 'Flux' refers wholly to the metallurgical phase of the operation; 'ore' refers to the outcome of exploitation in its completeness.

Case No. 5 involves the change of status due to a sudden influx of water in a mine, destroying the profitable character of the operations. Later, cheaper power becoming available, a profitable basis is regained. What happens to the 'ore' meanwhile? The position is one not to be inferred or described by the use of a single term; by the time the engineers had indicated their hope or their despair of overcoming the influx of water, it would be soon enough to select a term expressive of altered economic conditions. Certainly the 12 dwt. gold-bearing quartz in the Tasmania mine, where such a water difficulty exists, is not 'ore,' because the mine has been operated at a loss for two successive years and is now to be shut-down. Such quartz as has been opened-up can be stoped advantageously simply because a large part of the cost involved in development and general expense has been written off; therefore, the favourable result of breaking and milling it will represent a diminution of loss already incurred but not a profitable piece of mining.

Reviewing the general nature of the problem illustrated by the foregoing cases, we reply to Mr. Herzig that when the economic conditions are uncertain or peculiar, so as to obstruct a confident conclusion as to the margin of profit derivable from a mineral deposit, it is not a matter to be regretted if the engineer, instead of misusing the term 'ore,' with its suggestion of economic gain, finds himself compelled to employ terms that may reflect the uncertainties of the position. We proffer a sixth case. In the report of a Rand mine we find 2,000,000 tons of 4 dwt. stuff included in the 'ore reserves' and labelled 'unpayable ore.' This is mentally dishonest and grossly misleading. Two million tons of anything is impressive, and if two millions of them are included in the reserve, we may presume that they are not negligible. The ore reserve of a gold mine is its actual asset. Two million tons of 4 dwt. stuff is, today, on the Rand, just so much rubbish. Two million zeros do not aggregate sixpence. The alternative is obvious. The mine contains 2,000,000 tons of banket containing 4 dwt. gold; this has no present value, but, in the course of time, it may become a source of profit. Such a note might be tucked away in an inconspicuous corner, as a matter of remote interest, but it should not be included in the vital statistics of a mining company.

So we come round again to the definition formerly proffered: "'Ore' is metal-bearing rock that, at a given time and place, can be exploited at a profit." We submit that this interprets the fundamental ideas involved in the ordinary intelligent usage of the term. Even the gentlemen who speak of 4 dwt. banket as 'ore' are not unmindful of the suggestion of profit. That is why they use it. That is why others use it. As the earning of profit—or the making of money—is the main purpose of mining, it is well to have a term applicable to such mineral as is likely to be a source of profit. With the geologist's or the mineralogist's use or misuse of the term we are not greatly concerned.

When a geologist speaks of an 'ore deposit' he means a deposit of mineral suitable for profitable exploitation or a mass of metallic mineral so concentrated as to be the objective of industry. Until he is assured by the miner that it has economic value, he had better call it 'mineral.' Otherwise the whole crust of the earth is 'ore,' for all of it contains minerals and metals of varying value in the arts. One modification may be made, namely, to excise the word 'profit' from the definition. A mine may be operated by a government or by a private owner at a direct loss, but at an indirect gain, in so far as the operations give employment to citizens or tenants whom it is advantageous to keep at home. Other reasons might be instanced for operating a mine at a temporary monetary loss. Moreover, 'profit' is an elusive term, itself needing careful definition. To introduce it into the definition of 'ore' is undesirable. We drop it and amend the definition thus: "Ore is metal-bearing rock that, at a given time and place, can be exploited to economic advantage." The word 'economic' should serve to warn geologists, chemists, and journalists to tread warily. Again, as the limiting factors of time and place are of the essence of economics, we can now drop the qualifying phrase, so that the definition finally emerges thus: Ore is metal-bearing rock that can be exploited to economic advantage.

A Good Example.

At the annual meeting of the Nundydroog company, a shareholder wanted to know "whether any person with inside information had divulged or made use of it at the time when Nundydroog shares fell from 34s. to 22s. immediately before it was announced that the board had resolved to reduce the monthly crushings." To this the chairman, Capt. W. B. McTaggart, replied that "the directors did not deal or speculate in the shares of this or any other company with which they were connected, and that they had never done so." He referred to the fact that gentlemen on the Stock Exchange scrutinized the reports from the mines more carefully than most shareholders, and from such scrutiny they could anticipate that a reduction of output must follow the unfavourable developments on the lower levels. The gallant chairman closed by stating that to ask the directors to account for the slump was "almost an insult." Evidently the suspicious shareholder thought he was attending a Rhodesian meeting. As far as we know—and we make it our business to know—the suggestion of share-dealing by the Nundydroog directorate is without basis of fact. Accustomed as we are to looking for a sinister connection between share fluctuations and the speculations of those who abuse their position as trustees, we deem it the barest justice to say that the management of the Indian gold mines has been honourably free from anything of the kind. On the contrary, this detachment from market operations has been a source of annoyance to the gentlemen of Throgmorton street because the managers of the mines, namely, the firm of John Taylor & Sons, have been loyal to their trust, to the extent of preventing the issuance of information likely to cause unwarrantable anxiety or undue elation. Such a policy would be impossible in the case of the ordinary Rhodesian company, but as regards the Indian mines it has been justified as a means of protecting the best interests of the shareholders, who, for the most part, are real 'investors,' that is, they hold the shares for the income derived therefrom and not for the enhancement of the principal likely to follow favourable developments. 'Bulls' and 'bears' find the Indian department too stolid. The shareholders have sufficient confidence in the management to sit tight year after year, drawing their dividends, attending the annual meetings, and feeling sure that whatever may be the vagaries of ore deposition these will not be utilized to facilitate a gamble on the Stock Exchange.

PERSONAL

ROBERT ALLEN will deliver a course of six lectures on the cyanide treatment of gold and silver ores at the Sir John Cass Technical Institute, Jewry street, Aldgate, E.C., on Tuesday evenings at 5.30 p.m., commencing April 21.

W. T. ANDERSON, manager of the East Rand Proprietary, is expected in London.

PHILIP ARGALL & SONS have been appointed consulting engineers and managers for the Iron Silver Mining Co., at Leadville.

HOWLAND BANCROFT has gone from Denver to Peru.

H. C. BELLINGER, from May next, will reside at Spokane.

W. DE L. BENEDICT is at San Francisco.

THOMAS BREAKELL started on March 21 for Siberia and Asia Minor.

C. J. BRODERICK has left for the Altai as field geologist for the Russo-Asiatic Corporation.

A. H. BROMLY left by the *Mauretania* on March 26 on his way to Jamaica.

W. A. CARLYLE is making his periodical inspection of the Foldal mine, in Norway.

GEORGE P. CHAPLIN, for Bruce Marriott & Co., has returned from Burma.

JEROME J. COLLINS left for Northern Nigeria on March 25.

JOHN COOPER is with the Cinco Minas Mining Company, Magdalena, Jalisco, Mexico.

WALTER CURRIE is home from Rhodesia.

GORDON F. DICKSON has moved his office to 45 Broad Street House.

PERCY N. FURBER sailed on March 28 for New York.

B. G. C. GARD'NER has gone to Siberia.

HARRY D. GRIFFITHS left on March 19 for Bombay, to return in June.

HENRY HAY left on April 1 for California.

JAMES D. HAY, of the Hutti Mines, is home from India.

J. B. HASTINGS, of New York, is on a visit to Liverpool.

W. L. HONNOLD is retiring as managing director for the Consolidated Mines Selection Co., at Johannesburg, to return to America.

H. C. HOOVER and J. W. BOYLE were on the *Lusitania* arriving March 16.

THEODORE J. HOOVER is on his way to the Burma Mines.

W. F. HUME is at Helwan, Egypt.

CHARLES HUNTER is home from Pigg's Peak, Swaziland.

C. H. JAMES left for California on March 26 to take charge of the Oro Fino mine in El Dorado county.

CHARLES JANIN has returned from Tcherden, Russia.

J. T. KEATING and HERBERT MACKAY have left for Colombia.

C. E. KNECHT, consulting engineer of the Brakpan, is home on furlough.

R. B. LAMB is here from Toronto.

BENJAMIN MADEW has resigned as consulting engineer to the Central Mining Corporation and has returned to England.

GEORGE C. MASTER is in charge of the Karama prospect in the Ninkada district, Nigeria.

FERDINAND MCCANN has been appointed cyanide superintendent for the Keystone Mining Co., at Aroroy in the Philippine Islands.

GEORGE NATHAN is retiring from the General Mining & Finance Corporation.

OSCAR NEWHOUSE has returned to London from Dawson.

WALTER G. PERKINS is recuperating from an operation for appendicitis.

ROBERT M. RAYMOND sailed on April 8 for New York.

MALCOLM ROBERTS, manager of the Aramayo-Francke mines, has arrived from Bolivia.

J. R. H. ROBERTSON is coming home on leave from the Mysore mine.

JOSEPH A. SKERTCHLY has left for Lillooet, British Columbia.

RICHARD STANTON has gone to Peru.

A. W. STICKNEY passed through London from Boston where he took his examination for a doctorate at Harvard and proceeded to Kyshtim as field geologist for the Kyshtim and Tanalyk companies.

L. C. STUCKEY is home from West Africa.

GUY S. M. TAYLOR has returned from Australia.

W. F. A. THOMAE left Fremantle on March 30, on his return to London.

S. C. THOMSON is expected here from Johannesburg.

H. W. TURNER has arrived from San Francisco and has been retained by the Russian Mining Corporation to make a geological report on their new holdings in the Altai district, Siberia.

EDWARD J. WAY has opened an office as consulting and advisory engineer in the Cullinan building, Johannesburg.

MORTON WEBBER is in Montana.

T. WEIR has left for Naraguta, Nigeria.

ARTHUR YATES is manager of the Drumruck and Endrick mines in Kirkcudbrightshire, Scotland.

SPECIAL·CORRESPONDENCE

TORONTO.

Cobalt.—That the production of this district reached its maximum in 1911, and that a process of gradual decline has set in, is the opinion expressed by Thomas W. Gibson, Deputy Minister of Mines for Ontario, in his summary report of the mineral production of the Province for 1913. The production for last year was 29,681,975 fine ounces of silver as against 31,507,791 oz. in 1911—a decrease of 5%. Evidences of the correctness of Mr. Gibson's view are furnished by the reports of some of the leading producers, indicating diminishing outputs or increasing cost of production. The Nipissing, as has been anticipated for some time, has reduced its returns to shareholders by cutting off the 2½% bonus, which has been paid for some years along with the quarterly 5% dividend. The annual statement of the McKinley-Darragh for 1913 shows largely decreased profits and diminished ore reserves. The total silver recovered during the year was 2,214,026 oz., compared with 2,717,383 oz. in 1912, and the net profit was $771,487—a decrease of $382,361. The reserves have decreased from 5,368,500 to 3,210,000 oz. and the cost of mining has increased from 18½ c. per oz. to 22 c. The Hargraves mine has closed-down after five years of continuous operation at a cost of over $250,000, as the yield was not nearly equal to the outlay. The Crown Reserve is improving its position. A vein discovered some two months ago at the 150-ft. level has opened up satisfactorily. The drift has attained a length of 150 ft. in high-grade ore associated with about 6 ft. of milling ore, and another promising high-grade vein has been found. The Seneca Superior has declared a bi-monthly dividend of 10% and a bonus of 2½%. The annual report shows an output of 1,085,774 oz. and reserves containing 3,460,000 oz. as compared with 1,150,000 oz. last year. The net profit was $286,626. Operating expenses were 12½ cents per oz. Four levels of high-grade ore are being worked.

TOUGH-OAKES MINE. GULL LAKE IN BACKGROUND.

Active operations have been resumed on the Right of Way. A vein on the 120-ft. level is making good ore. It has been followed for 150 ft. and carries 2 inches of 3000 oz. ore. The Chambers-Ferland will put down its exploration shaft to the 435-ft. level before beginning to cross-cut, the object being to sink near the contact with the Keewatin, as on the adjoining Nipissing property the ore-zone occurs 75 or 100 ft. above the Keewatin contact. After a highly exciting campaign, the old directorate of the Temiskaming has been ousted and a new board chosen to represent the controlling interests of the Beaver mine, headed by F. L. Culver. At Cobalt Lake a winze is being put down on No. 2B vein from the 225-ft. level. Sixteen feet down, the vein shows improvement carrying 2½ in. of 5000 oz. stuff with 8 ft. of mill-ore on each side. The output last year was 973,676 oz. and the ore reserves contain 4,796,940 oz. The capacity of of the mill is to be increased to 175 tons per day to allow of the treatment of low-grade ore.

Porcupine.—As was foreshadowed by the difficulties caused by shortage of power, the output of the Dome for February shows a considerable decline. The mill treated 12,010 tons of ore yielding a profit of $69,000, as compared with $111,500 profit in January, the poorest return since last August. The decrease in the grade of the ore crushed at the Hollinger is stated to be due to the policy of the management. As large bodies of low-grade have been opened up by recent development, the high-grade reserves of No. 1 vein are being conserved, and a large tonnage of low-grade sent to the mill. The directors of the Jupiter have obtained the funds required to develop and equip their property by an arrangement with the McKinley-Darragh company. It is understood that in return for the advances necessary to redeem the bond issue and continue mining operations, the McKinley-Darragh will receive a half-interest in a new company to be formed later.

Canadian Mining Institute.—The sixteenth annual meeting of the Institute was held at the Ritz-Carlton hotel, Montreal, on March 4, and proved an interesting and successful occasion, though the attendance was not so large as last year. The President, Dr. A. E. Barlow, of Montreal, in his opening address, dealt with the satisfactory progress of the Institute, the membership of which had been increased by 113 during the year, bringing the total number up to 1029. Two new branches had been organized, making eight altogether. Dealing with the mineral resources of Canada, he strongly advocated the proposal now under consideration by the Government of granting a bounty on iron ore produced in Canada. Reports on the mineral production of Canada and the provinces of Ontario and Quebec during 1913 were presented. The preliminary report of John McLeish, chief of the Division of Mineral Resources in connection with the Canadian Department of Mines, gave the following figures for last year's output: The total value of the mineral production was $144,031,047 as compared with $135,048,296 in 1912, an increase of 6·65%. Of the total $66,127,821 was metallic and $77,903,226 non-metallic. The principal items on the metallic list were, Copper 76,975,832 lb., value $11,753,440; Gold 784,525 oz., $16,216,131; Pig iron 1,128,967 tons, $16,540,012; Lead 37,662,703 lb., $1,754,705; Nickel 49,676,772 lb., $14,903,032; and Silver 31,750,618 oz., $18,984,012. There was an increased production in all the metals except copper and silver, the most important being in gold, due to the large increase from the Porcupine district. The leading non-metallic product was coal, the output of which was 15,115,089 tons of the value of $36,250,311. The coal output of Alberta had increased by 27%, but that of British Columbia showed a diminution of 15% on account of labour troubles. Cement showed an increase, 8,658,922 bbl. being produced, to the value of $11,227,284. The output of petroleum, which has been steadily declining for some years, showed a further decrease, having fallen to 228,080 bbl. valued at $406,439.

Kirkland Lake.—Dr. Hatch has come and gone, taking with him a bulky lot of samples. Mr. D'Arcy Weatherbe, representing the Rose and Van Cutsem group, has also inspected the Tough-Oakes and other mines in the district. His report will be awaited with keen interest, as he made a favourable local impression. Mr. H. H. Johnson is expected from London shortly. The report of Mr. Frank Loring on the Tough-Oakes would be more convincing if he had no interests in other claims in the district. On the whole the tactics of the Rhodesian group are not liked here, and it is feared that their operations will hinder the legitimate development of a promising locality. During the last two months steady progress has been made with the installation of the electric plant at Charlton, which will supply power to the mines and mills at Kirkland Lake. The transmission line has been erected to within a mile of the Tough-Oakes mine.

JOHANNESBURG.

The annual meeting of the Association of Mine Managers of the Transvaal was productive of some interesting remarks by Mr. A. E. Payne, the retiring president, on the causes of the recent unrest. Beginning with the strike of 1907, which was caused by asking the machine-stoper to supervise three rock-drills instead of two, he pointed out that during that strike the natives and Chinese ran the machines to all appearances just as well without the white miners, which went to prove that the latter were merely supervisors. The collapse of the strike rankled in the minds of the white workers, and their antagonism acquired momentum by the added force of some real grievances, of which phthisis was predominant. Some of these grievances were removed by the Krause Commission, principally by the provision to govern by written agreement the relations of the miner to the employer. To prevent misunderstandings due to incorrect interpretation of the clauses of these agreements, managers were compelled to employ larger numbers of technically educated shift-bosses and mine-captains in place of officials of the purely practical type who were in closer touch with the men under them. The relations of employer and employed became more of a legal and less of a personal matter because of such documentary limitation. By this time, 1911, the ceaseless changing of underground employees from mine to mine, due principally to the violent fluctuations in earnings caused by the inelastic form of the contract agreement, began to occasion much discontent, and the wastage from phthisis became acute. To remove the friction arising from the irregularity of the sums earned on flat contract, the Association endeavoured to get all the mines to adopt the guaranteed day's pay plus contract system. But unfortunately just at that time good men were scarce and managers were competing with one another by means of high contract prices to obtain their services, and consequently the Association was unable to carry its wishes into effect. In brief, the causes of the unrest may be traced to the advancing skill of the native and the advantage taken of it; to the attitude of the Legislature in imposing regulations to break-down by rigid agreements the mutual goodwill that existed; and to the menace of phthisis. In alluding to the future, Mr. Payne considered that the time had come for employers to permit that equal opportunity between the black and the white which had been so long barred in the industry; and that trade-unions must play the game when bargains are entered into, and when they do not they must help to repair the damage by contributing their share of the resulting loss.

The Economic Commission having issued its report, its main conclusions may be now summarized in concise form: The cost of living on the Rand is 40% higher than in America and 80% higher than in Europe. Wages are 40% higher than in America and 225% higher than in Europe. Miners' wages, in view of the disadvantages under which they labour, are not unreasonably high. The application of the piece-rate system to natives would increase productivity. It is undesirable that barriers should be placed in the way of non-white labour by the State or local authorities to prevent the advancement to any kind of work of which non-coloured workers are capable. A minimum wage is not desirable. Voluntary agreements between employers and employed are more likely to bring about satisfaction than State action. Trade-unions should be recognized. The contract system should be abolished in favour of day's pay or a bonus system. The cost of working-class living (food and rents) is: Witwatersrand, 100; S. Africa, 87; United Kingdom, 49; France, 54; Germany, 56; Belgium, 45; U.S.A., 71; Canada, 70; Australia, 61; New Zealand, 57. Taking the same order, the index numbers of wages of skilled artisans per hour are: 100, 77, 28, 18, 21, 15, 69, 67, and Australia 60; and the real wages (wages in relation to the cost of living) are: 100-110, 92-100, 63, 43, 46, 44, 101, 100, 98, and New Zealand 102. Industrial success cannot be achieved by the white man in South Africa by keeping the coloured man down, but by his raising himself up. The recommendations advise periodical inquiries regarding the cost of living, an advisory council for native questions, an industrial commission in connection with laws affecting trade-unions, industrial disputes, and wages, the formation of conciliation boards, registration of trade-unions, protection of non-unionists, a status for officials of registered trade-unions, a Factory Act for hours and conditions of labour, one day's rest in seven, overtime at the rate of time-and-a-quarter, periodical industrial reports, and the centralization of the administration of all industrial and mining legislation in one office. The foregoing epitome gives the essence of the Report, but those interested in the subjects dealt with would do well to peruse it carefully from cover to cover. An enormous volume of useful data bearing on the social and economic position in South Africa is embodied in its pages. It supplies accurate figures and impartial judgments which will both be invaluable when drafting future legislation.

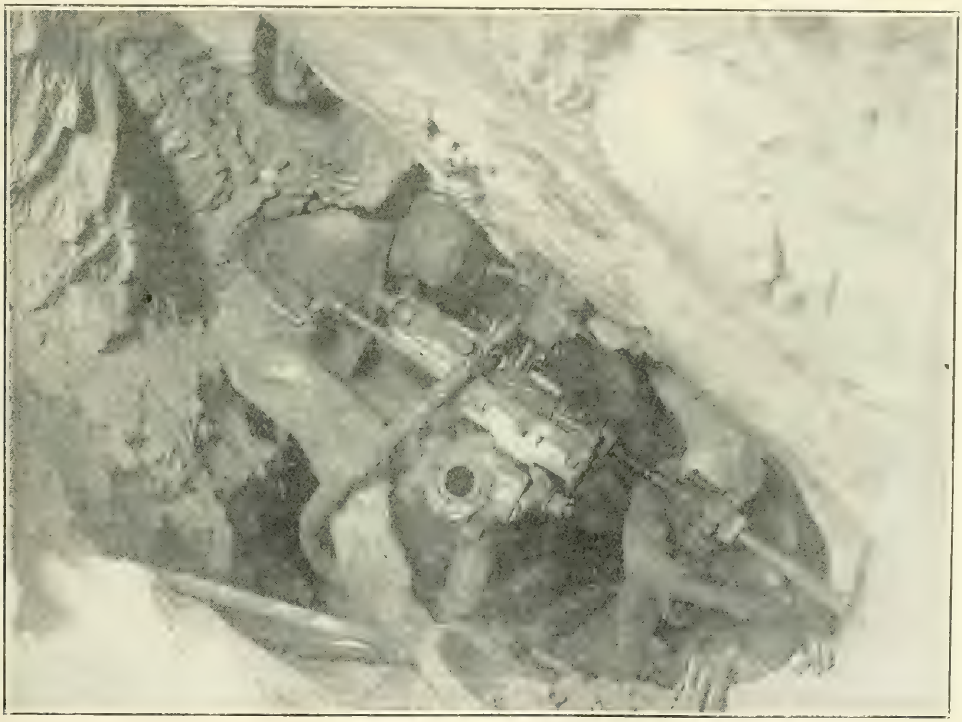
The colour bar is being weakened daily, and soon, on receiving a push from Government quarters, it must break down altogether. At an influential meeting of Cape coloured people, held recently in Johannesburg under the auspices of the African Political Organization, a resolution was unanimously passed praying the Government to amend the Mines, Works, and Machinery Regulations so as to eliminate the unjust colour restrictions and to substitute competence and efficiency as the qualification. An extensively signed petition is to be presented to the House of Assembly pointing out that coloured persons are placed under serious disability by the Regulations solely on the ground of colour. These restrictions prevent competent coloured artisans from earning their livelihood in the Transvaal and Orange Free State by following the trades of carpenter, engine-driver, miner, etc., as they are freely allowed to do in the Cape Province. The petitioners suggest that where-ever the term 'white' appears in the Regulations the term 'competent' might be substituted; and that wherever a distinction is made against the coloured worker to his detriment the differentiation might be removed. Apart from the natural ambitions of the coloured workers themselves, mere commercial commonsense will undoubtedly lead to the throwing open of much aristocratic mining work to the skilled coloured man. For his mining knowledge is frequently far ahead of that possessed by the white miner who directs him; and in this position his conduct is fortunately analogous to that of the well drilled private who performs the correct evolution in response to the wrong command given by an ignorant superior.

Petroleum prospects in the Union are, according to the official report of Mr. Cunningham Craig, not at all promising. It appears that the system of prospecting so far adopted has been characterized by an entire want of system, that, in fact, it has been both unscientific and useless. Some consolation may be derived from this judgment in view of the possibility of the expert prospector supplanting the bungling amateur and obtaining more encouraging results. Mr. Craig states that whatever theory may be held as to the origin of petroleum, the determining factors are the presence of sufficient carbonaceous material from which oil can be formed, the conditions of deposition, and the geological structure; in a locality where these three conditions are favourable, an oil-field can be predicted with certainty. Professor Vivian B. Lewes, before the Royal Society of Arts last April, advised geologists to work back and trace out the shores of the big seas in the Carboniferous and Tertiary days, and they would find areas that in all probability promised best for the finding of crude oil. According to Sir Boverton Redwood and Mr. Beeby Thompson the essential factors to the existence of petroleum are:

1. Marine Tertiary beds.
2. An anticlinal structure.
3. Limestone, sandstone, and shale.
4. Brine lakes or salt deposits.
5. An impervious covering of shale or clay.
6. Bitumen or asphalt is an unfailing indication.

In the Union it appears that the Karroo system is the only one worth prospecting, and that favourable geological conditions are limited to a narrow strip at the southern edge of the Karroo in the Cape Province. There is, however, a possibility that areas in north-eastern Natal might furnish favourable structures. Before abandoning hope of striking petroleum Mr. Craig considers that the area south of Aberdeen, near Jansenville, Saxony, and Klipplaat Stations, should be examined. Boring with a diamond-drill is too slow and expensive, though where dolerite obtains it is often necessary. A combination rotary and percussion drill, with a steel derrick, should be used. Quite a small production of oil would pay in South Africa; while even if oil be not struck, it is quite possible that natural gas may be discovered under sufficient pressure to prove a valuable commercial asset. In the neighbourhood of Gruisfontein, in the Heidelberg district, further prospecting for gas is likely to be successful, and in the folded belt of the Karroo system the striking of gas is probable. Finally, he is of the opinion that an oil-shale industry offers the best chances of success, and urges that no effort should be spared in this direction.

The plumbing of deep vertical shafts for the purpose of connecting the surface with the underground survey is a task that no surveyor undertakes without reluctance; for he is aware that the erratic action of air currents on the wires may lead to an error that he is powerless to prevent. In vertical shafts the usual plan followed is that of dropping two or four plumb-lines and placing a theodolite so that it shall be in line with the wires or form a triangle with them. In the past many excellent surveys were carried out in this way where the shafts did not exceed 1000 ft. in depth, and even some accurate work was accomplished with shafts of much greater depth. Nowadays, however, it is recognized, at least by those who have had experience, that, on account of air currents, it is tempting providence to use the ordinary plumbing methods with very deep shafts. In view of the great possibility of error, Mr. F. G. A. Roberts, the manager of the Knight Central mine, went to work some years ago and after much thought and experimenting succeeded in working out a highly ingenious system, now universally known to surveyors under the name of the Roberts shadow method. Simple as the method really is, a full understanding of its application and many clever features is scarcely possible without the aid of diagrams and much detailed description. Its essential outlines can, however, be made intelligible. To begin, a tentative definition is required: a plumbing method whereby a rapid transference of several parallel base-lines to the bottom of the shaft is effected and their exact positions determined there by the shadows of the wires. The method is performed thus: Across the collar of the shaft are laid four straight-edges, notched in exact uniformity every six inches. One pair is for holding the two wires that demarcate one base-line, and the other pair for the two wires that demarcate the other and parallel base-line. By moving the wires at intervals into adjoining notches the two lines may be made to move across the shaft and in this way a dozen or more base lines are rapidly arranged and transferred below. Alongside the collar a theodolite is set up over a known point and sighted across all the straight-edges. The latter are then adjusted until a similar notch in each one is intersected by the vertical wire of the telescope. When this is done the exact position of all wires lying in the reference notches are easily determined and all their subsequent positions readily calculated. The rest of the procedure on the surface consists in moving the wires along, a notch at a time, on a signal from below, and in sighting the reference notches to see that they maintain their alignment. In the mine the first act is to fasten plumb-bobs of symmetrical design weighing 75 lb. each



KAFFIR OPERATING MACHINE-DRILL IN THE MEYER & CHARLTON MINE.

to the ends of the wires. These wires are made of specially drawn galvanized plough-steel with a breaking strain of 120 tons per square inch. The diameter of the wire is 0·04 in. and the actual breaking strain 330 lb. Next, two long boards, painted white, are fastened, as nearly as can be determined, parallel to the straight-edges on surface and a few inches outside each set of end wires. These boards are for marking the shadows on, and they are the essence of the method. Outside the boards and nearer to the ends of the shaft are placed the lamps. The design and position of these is most important. They must throw a narrow vertical beam and be so situated that the shadows shall be of the right consistence as well as being on the prolongation of each base-line. On the projecting end of each board is screwed a small bracket, under which a theodolite can be set up. These brackets, later in the day, by means of a theodolite, are connected with the underground survey, and by measurement with the marks on the boards. The observing routine is conducted thus, illustrating with one base-line only, as all the others are repetitions: The lamps having been placed in line, two observers take up their positions, one behind, say, the north board, and the other behind the south board. As the magnified shadow of the south wire moves across the north board the observer there scales off its mean position and as it returns to that position he calls out "mark," and the observer at the south board at once makes a mark with a pencil on the sharp shadow of the same south wire. After a dozen calls the mean position of the shadow of the south wire, as shown by the marks an the board, is fixed. Then the north wire has its shadows marked in the same way. The result is a base-line slightly longer than that demarcated by the wires, its ends fixed by marks on the boards. From six to a dozen lines are transferred in this manner; then after the brackets on the boards have been surveyed, the boards are removed to the surface and all the appliances removed. The interpretation of the boards is now the important problem. This is accomplished by laying a straight-edge and the two boards side by side with one another, and inspecting the coincidence or the want of coincidence of the marked boards with each other and with the straight-edge. Finally, after the exercise of much experienced judgment, a mean line representing the whole underground series, or representing those lines that are acceptable by reason of the normal conduct of the wires, is decided upon. Then follow some ordinary trigonometrical calculations, and the whole survey is complete. The survey of the Springs Mines, down shafts 3450 ft. and 3700 ft. deep respectively, has just been carried out by this method, but as the headings of the main incline, 4500 ft. long, will not connect for about two years the proof of the success of the method in this instance must be deferred. There is little doubt, however, that complete success will be achieved, for in the case of the Brakpan, with two vertical shafts over 3500 ft. deep and an incline connection 4430 ft. long, the error in horizontal alignment when the headings met was only three-sixteenths of an inch.

The East Rand Proprietary is going back rather than going forward, as the following comparison shows:

	Year ended Dec. 31, 1912	Year ended Dec. 31, 1913
Yield per ton from current ore....	32s. 1d.	30s. 9d.
Cost ,, ,, ,, ,, ,, ...	20s. 10d.	19s. 10d.
Profit ,, ,, ,, ,, ,, ...	11s. 3d.	10s. 11d.
Net profit..............................	£909,108	£831,565
Dividend..............................	25%	25%
Balance of cash and cash assets...	£198,410	£168,335
Profitable mining tons developed during year........................	1,029,106	904,046
Percentage of total during year...	58	59
Contents, dwt. per ton	8·2	6·9
Ore reserve, tons	6,013,300	5,600,000
Contents, dwt. per ton...............	6·8	6·7

The issued capital is £2,445,897 and the debenture debt is now £1,350,000. The Superintending Engineer points out that not enough development was done to maintain the ore reserve in a sound condition, the chief contributory causes to this unsatisfactory state of things having been the delay in installing the big pumping-plant and the shortage of native labour. The serious falling off in the value of the ore developed during the year is largely due to the restricted development in the richer parts of the mine, necessitated by the proximity of the development headings to the waterlogged dike. Accepting these explanations, it may be as well to point out that the bad effect of the development retrogression, in the face of the poor labour supply, will take a long time to reverse, and also that the present year will, in this respect, probably show no improvement. Indeed, the language of the report indicates that the expectation of securing increased development and maintaining last year's profit is slender. With regard to more general matters, it is interesting to note that the management has introduced a scheme by which it hopes to secure a heartier co-operation between the mine control and the employees. The essential features of this laudable departure are as follows: Underground employees will not be dismissed by any official under the rank of mine captain, and then only with the approval of the section manager. Engineering employees will not be dismissed by any official under the rank of section or workshops manager, and then only with the approval of the mine manager, chief mechanical or chief electrical engineer; and reduction works employees, by any official under the rank of battery or cyanide manager, with the approval of the chief metallurgist. A representative committee of 12 will as occasion arises lay before the management the views of employees on general questions. A grievance board of three members selected from officials will investigate the case of any employee who considers that he has not been dealt with fairly by the head of his department. An appeal from the decision of the grievance board may be made to the general manager, superintending engineer, and chairman of the company. This scheme, which was designed by Mr. W. T. Anderson, the superintending engineer, in consultation with representative employees, marks a decided advance on the haphazard methods hitherto in vogue in dealing with subordinates.

NEW YORK

Zinc Ores.—Not long ago I referred to the successful results attained in large-scale experiments with the Johnson electric furnace for smelting zinc. It is now announced that an interest in the Johnson patents has been acquired by Hayden, Stone & Co., the bankers. The Hayden-Stone interests control the Butte & Superior, with its big zinc output, but this is scarcely an explanation, for the electric furnace cannot compete with the retort process for the rich zinc concentrate that the Butte & Superior produces, being devised to handle complex zinc-lead-copper ores. A more plausible explanation lies in the fact that Mr. Hayden is friendly with H. C. Hoover, who is interested both in the Burma mines, in Burma, and the Ridder mine, in Siberia. In both of these are found large bodies of complex ore; zinc, lead, copper, with gold and silver, which would be exceedingly refractory to any ordinary metallurgical process, but which are just the material for which the Johnson electric furnace was devised. If the furnace proves as successful in practice as it has in experimental work, we shall soon see electric smelting being conducted on a large scale in these remote places.

Copper.—The zeal for large-scale low-cost processes for the recovery of copper has spread to the Lake Superior district, and the share market statisticians have already computed that the Calumet & Hecla can recover 520,000,000 lb. copper from its old tailing, now on the bottom of Torch lake, and the Tamarack can similarly recover 112,000,000 lb. copper. These companies for years have been allowing the tailing from their mills to flow into Torch lake. Later work demonstrating that a considerable part of the copper content of the tailing is recoverable at a profit, it has been decided to reclaim and rework them. The Calumet & Hecla tailing is in two piles, of 20,000,000 tons each, rising above the surface of the water in the lake. A suction-dredge 110 ft. long and able to draw material from a depth of 100 ft. beneath the surface is now under construction. By what process the tailing will be treated after it has been pumped to the shore has not been disclosed, though the announcement that a 75% recovery is expected from the tailing from ordinary wet concentration pretty clearly indicates that oil flotation will be used, since there is no possibility that any hydrometallurgical process has been devised which will recover $10\frac{1}{2}$ lb. copper per ton from material containing 14 lb. per ton, at a cost of 6c. per pound of copper produced.

Nickel.—Last year the financial journals announced that the Canadian Nickel Corporation was to be launched, with a capital of $30,000,000. The crew of this argosy were supposed to be F. S. Pearson, J. R. Booth, J. F. Taylor, Walter Gow, Miller Lash, and others. The organization was supposed to have developed 10,000,000 tons of nickel ore in the mines under its control, and to have a big future as a producer and money-maker. Someone must have forgotten to grease the ways, for the launching never came off. It was rumoured that this was because of the unfavourable state of the money market, but as a matter of fact money has been available in abundance for well secured investment. A more probable explanation is seen in the fact that the International Nickel Co. has practical control of the nickel market in this country, while the Mond Nickel Co. similarly takes care of most of the foreign markets. A new producer would find it exceedingly difficult to disrupt the present *entente cordiale* and create an open competitive market. It looks as though discretion had prevailed over valour.

The mining profession and industry in in New York is, like Gaul, divided into three parts. There is a group of companies that have settled down into standard practice and are pursuing the even tenor of their way without much change and without taking any marked part in the activities of the metropolis. Such companies as the Oriental Consolidated, Cerro de Pasco, New York & Honduras Rosario, the Stanton companies, are examples. Then there are the enterprises that are actively expanding, developing new mines, building new mills, or devising new processes. These are real foci of activity and about them flutter swarms of machinery salesmen and engineers. The Hayden-Stone companies, the General Development Co., Guggenheim Exploration Co., United States S.R. & M. Co., and, to a less extent, the Phelps-Dodge companies and the International Nickel Co. are all examples. Finally there is a third group, that centres around the Stock Exchange, but more especially about the Curb, the open-air market that corresponds to the Paris Coulisse. Here is feverish activity over matters that to the other groups seem trivial, and happenings of no importance to the rest of the world take on vital significance. For example, most people now regard the Goldfield district of Nevada as a back number, but for the last few months it has been the centre of interest on the Curb, and a person who had no other means of information than brokers' circulars would infer that it is the most active and interesting mining district of the country. Looking beneath the surface, it appears that all this activity springs from the fact that J. W. Sparks & Co., a brokerage house, bought 100,000 Atlanta shares some months ago and have since been endeavouring to dispose of them to the public, with only moderate success, but meanwhile creating marked activity in all the Goldfield stocks. Similar flurries are actuated by similar motives, and the seriousness with which the Curb takes itself is only equalled by the unconcern displayed toward it by the other groups. This must not be taken too literally, however, for the Hayden-Stone companies bulk even larger on the Curb than they do in the operating world. I have already referred to the contrast between the Hayden-Stone promotion, the Alaska Gold Mines, which is a prime favourite on the Curb, and the Bradley venture, the Alaska Juneau, which is unknown to that busy mart. [We referred to these enterprises at some length in our last issue. They are the last word in low-grade gold-ore treatment. The illustration on the opposite page shows Treadwell in the foreground and Juneau across the Gastineau strait.—EDITOR.]

SAN FRANCISCO.

Electrical precipitation of suspended matter is now being applied in a number of industries on the Pacific Coast and elsewhere in the Western states. It will be remembered that Sir Oliver Lodge in 1905 called attention to the possibility of using intermittent electric discharges of high potential to throw down liquid and solid matter suspended in the atmosphere, and proposed to use the method in dissipating fog. While this particular application has never been made on a large scale, though the project has not been abandoned, the method has found other uses. As a result mainly of the brilliant work of F. G. Cottrell, formerly of the faculty of the University of California, and now chief physical chemist for the U. S. Bureau of Mines, the method is finding wide use. There was at first great difficulties in providing a suitable current, as the old static machines were severely limited in capacity. The discovery that an alternating current could be transformed by picking off merely the crest of each wave, and the development of suitable contactors for doing this, has made possible the steady and economical production of high potential current. Whereas in 1911 operators had only 30,000-volt currents at their service in practice, it is now possible to obtain voltages as high as 250,000. Another difficulty was that of finding discharge plates which would give an even distribution of current with such voltage. Fortunately it develops that this difficulty is not so great with the very high voltage as with current of moderate intensity, as a 25,000-volt current has come to be considered. The process is therefore rapidly making headway, all the more so since it now permits recovery of by-products that often more than pay for the cost of operation, whereas the first motive for introduction of the process was the abatement of nuisances.

One of the early applications of the process was dehydration of crude petroleum in the oilfields. As the oil and water occur together and readily form an emulsion, this proved an important application and has been successful almost from the start. About the same time the process was applied to precipitating the SO_3 mist at acid works on San Francisco bay, and from there to the first work with smelter fume at the Selby works was a natural step. This was at a time when the smelting plants in Shasta county were in most acute difficulties with the farmers and Mr. Cottrell was called in by the First National Copper Co. to treat smelter fume at the Balaklala plant. This was a long step in advance, requiring construction of a plant of 100 times the capacity of any then in existence and the result has been likened to the successful surgical operation when the patient dies. While the SO_3 was precipitated, and over a period of weeks a recovery of more than 80% of the dust was made (individual units precipitating more than 90%), this was not sufficient under the terms of the Court order. The latter required that all dust be precipitated and the fume rendered harmless in every particular. Electrical precipitation, of course, does not affect the SO_2 in the fume. The plant was accordingly closed. Sufficient had, however, been accomplished to attract the serious attention of the guiding spirits of the A.S. & R. and Anaconda companies, and work has since been going on steadily at Garfield, Utah, and Anaconda, Montana. At Garfield a precipitating plant consisting of 5-in. steel pipes carrying the gases and acting as collecting electrodes, the discharging electrodes being wires stretched axially within, has been operated a month at a time treating gas from the basic converters. Later experiments were made upon gas from the roasters and blast-furnaces, the primary object being the recovery of dust of precious metals now lost. It is announced that a plant is to be built for treatment of all converter fume, and in rebuilding the flue system, space is left for a later erection of a precipitating plant to treat all fume. At Anaconda, experimental work is being done, and the process has been adopted for one or two uses. At Globe, the new plant of the I. S. & R. Co., which is being built to treat Miami and Inspiration ores, will use the process for precipitating dust from the driers and roasters and possibly for other uses later. The rights for the whole plant have been purchased. At a number of other smelters the process is being applied, and it now seems to have made a distinct place for itself. Incidentally it is finding uses in certain peculiar situations where ordinary methods of abating the smoke nuisance cannot be applied, and in southern California it is used to clear the smoke from portland cement factories from dust. Orange growers in the vicinity of the plants had complained that the dust, falling on the buds and fruit, diminished the crop and lowered its quality. One result of applying the new method is the recovery of a large amount of dust which proves to contain sufficient potash to be saleable as a fertilizer, in part to the same agriculturists who had objected to the material being showered over the groves. One further item of interest in this connection is that Mr. Cottrell has presented his patent rights, out-

LOOKING FROM DOUGLAS ISLAND TO JUNEAU.

side certain territory, to the Research Corporation which is administered by the Smithsonian Institution. The profits from royalties are, therefore, to be largely applied to further research in science and technology.

Discussion of anything electrical leads naturally to the thought of George Westinghouse, who died at his New York home on March 12. In many ways he, and his inventions, have benefited mining; while his first great inventions, the air-brake and various signal devices, were especially of benefit to transport; even they had their bearing on the mining industry. It was the persistent effort of Westinghouse that made the alternating current useful; and that current in turn has been a large factor in making possible long-distance transmission of power. His later work in perfecting and applying the steam-turbine built by Parsons has been hardly less significant, and in a surprising number of ways he has touched modern industry in all parts of the world. In many particulars he was a typical American so far as there is any such personage. At least, he was born of poor or but moderately wealthy parents, of German-Dutch descent, but living in this country since colonial days, he played around his father's machine-shop as a boy, studied in the public schools of a small New York town, left a small college before he completed his course, served as a volunteer in the Civil War, turned early to invention, became also a great manufacturer, became wealthy and a public figure, was electcd to honorary membership in numerous societies, went through a financial crisis and recovered, was a leader in establishing shorter working hours and better working conditions, and in short fulfilled all those ambitions with which young Americans usually start in life. He has left important inventions, considerable wealth, and an excellent example, and Americans are glad to honour him dead as they admired him alive.

Homestake.—The report of the Homestake Mining Co., recently distributed, shows that great concern to be in excellent condition. It is a far cry from the undeveloped series of quartz veins that Louis Janin examined for Hearst & Haggin, that pioneer firm of miners, to the position of third largest dividend-payer among the gold mines of the world, but Janin and Hearst & Haggin saw truly, and their faith in the property has been excellently seconded by the technical men who have built the plant and made it work, including the present superintendent, T. J. Grier, and his associates, B. C. Yates, W. J. Sharwood, C. W. Merrill, and A. J. Clark. In 1913 development covered 16,313 ft. of drifts and 686 ft. of rises. The depths of the shafts remain as they were a year ago, namely, Ellison, 1850; B. and M., 1550; Golden Prospect 1100; Golden Star, 1400; Old Brig, 800; and Golden Gate, 800 feet. Broken ore in the stopes amounts to 2,206,671 tons, an increase of 176,000 tons. The property is in fine physical condition, and prospects point to a long and profitable life. A modern change-house was erected for the miners, and a recreation building at Lead was built and is now ready for all of the company's employees. Results may be summarized as follows:

Ore treated, tons	1,540,961
Average value realized, per ton	$ 4·0148
Gold output	6,186,652
Balance from 1912	1,455,958
Other revenue	132,716
Total revenue	$7,775,326

Costs.	Per ton
Mining and 'dead work'	$1·480
Milling	0·254
Cyaniding sand, direct cost	0·104
Re-grinding	0·009
Cyaniding slime	0·086
Assay Office	0·021
Foundry and shops	0·061
Shafts	0·137
Hydro-electric plant and electric operation	0·028
Hospital, Recreation Building, etc.	0·106
General, including property purchase, taxes, timber, water, salary, survey, etc.	0·434
Total cost	$2·720

Dividends totalled $2,146,224, equivalent to $1·39 per ton, the total realized value per ton being $4·0148. The discrepancy in figures is due to other sources of income. It is also to be noted that these figures are based upon tons milled, which does not agree with tons mined. It is impossible with the figures at hand to state separately the actual cost of milling and mining per ton, nor is there any information given as to total ore reserves or recovery. Both are known to be satisfactory since the reserve is sufficient for many years and the tailing loss is understood to be about 24c. per ton; that from the slime-plant is about 8 cents. It is to be noted that at the Homestake much construction is charged into cost and not capitalized although recently new capital was issued against the cyanide plants, water system, hydro-electric plant, and other work that has been under way for some years back. There are no 'phantom profits.' The excess profits, above regular dividends, are divided between stockholders and workers, the latter receiving a 7% dividend on each man's pay in 1913. The Homestake is a great mine and the management is doing excellent work. It is to be regretted that the accounts as published are somewhat inadequate; we should like to see them classified more in detail. However, we believe this is not due to any indisposition to give stockholders and public all proper information.

Leaching copper ores is everywhere being attempted and it has just become known that the Mason Valley Mines Co. has been quietly building a leaching plant, though nothing has been said about it. However, copper ores are not the only ones being studied with a view to application of leaching methods. The lead producers are as anxious as anyone to obtain any advantage that may accrue from the revival and improvement of the older methods. The Bunker Hill & Sullivan company has an extensive series of experiments under way. While any hydro-method that will work will be welcomed, for the present studies are being made of dry chlorination somewhat along the lines followed by John L. Malm and his associates of the Western Metals Co., at Denver and Corbin, Montana. The general process has points in common with the Swinburne-Ashcroft and Brunner-Mond systems and previous attempts to use it in this country have not been economically successful. There are reasons for thinking that the lack of success was due to financial mix-ups as much if not more than the technical difficulties involved. These at least will be eliminated in case the Bunker Hill & Sullivan company goes so far as to erect a plant. A further guarantee of success is the fact that the technical studies are being made in co-operation with and under the supervision of the United States Bureau of Mines.

CAMBORNE.

Geology of Camborne Lodes.—At the recent East Pool meeting, Mr. W. J. Loring made a suggestion that the landlords owning this highly mineralized belt of country containing the most complicated lode system that existed in the world, so far as he was aware, should have complete surveys of the underground workings made on a common base, this to be followed by a report from a geologist. His idea was that the landlords should then hand the report embodying the deductions of the geologist to the various mines as a basis on which to conduct their future development policy. The suggestion is excellent, but one not likely to receive a welcome from the 'lords,' who, in the main, have a keen horror of anything involving expenditure, even though they may ultimately benefit considerably. But why cannot the mining companies combine and share the cost? If only a Chamber of Mines had been in existence, such a proposal might have received consideration. As it is, I fear nothing will be done.

Falmouth Consolidated Mines. — An effort is to be made to set this company, owning the Wheal Jane mine near Truro, on its feet again, though even if all the money asked for is subscribed, the balance available for working capital would probably prove inadequate. The present position is that the issued share capital is £119,683; there are encumbrances on the property in the shape of £90,000 participating 6% bonds, and £20,000 income bonds also bearing 6% interest but payable only out of profits. The present interest charges figure at £5400 per year. The new scheme provides for the suspension of payment for three years of (1) both interest and principal on all bonds, and (2) the unsecured trade creditors. It is proposed to create £35,000 prior lien bonds carrying 7% interest, and of these, £16,700 would be issued to the bank as security for its debt, and £10,000 would be offered to the existing bond-holders with a bonus of 100% in participating bonds, which would be released by the bank in exchange for their new security. A further £8000 of these released participating bonds would be set aside for gradual realization to meet the claims of unsecured creditors. The proceeds of the prior lien bonds would be applied in re-payment of moneys advanced by the receiver, to meet his costs and charges, to pay the preferential creditors, and the balance would be available as working capital. If the scheme is accepted and firm subscribers for a fixed amount are secured, then the bank will not press for payment of its debt before March 31, 1915. It is to be hoped that Wheal Jane will have a further chance, but the heavy interest charge and large share capital militate seriously against success, if success is to be measured in dividends to shareholders.

Carn Brea and Tincroft.—The fortitude of the shareholders was tried considerably in having to face a loss of £14,247 for the half-year ended December 31 last, but it must have been more galling for the able general manager, Mr. E. S. King, who has done his work under such depressing circumstances. The heavy drop in the price of tin and the fall in the content of the ore are things that no manager can control. The company needs adequate capital to vigorously develop this great range of mines; nobody doubts, if the necessary money were forthcoming, that a new era of success would be inaugurated, even with tin at its present price. In its absence, it was undoubtedly the right policy to curtail operations and to confine attention to those sections of the property that showed more immediate prospects of success. Had the mines in the past been adequately developed ahead of mill requirements, the present unsatisfactory position would probably never have been created. The North Tincroft section is now the mainstay of the company, and here, on the authority of Mr. King, there is approximately 60,000 tons of ore blocked out; but unless a vigorous policy of development in depth is taken in hand promptly, this reserve cannot be maintained. The average recovery for the half-year was only 12·19 lb. metal per ton, or 67% of the actual content of the ore. It is satisfactory to learn that for February the recovery was increased by 4 lb. per ton, and as a consequence a small profit was recorded, excluding capital expenditure. The first unit of the new mill is in a forward condition. Mr. King is hopeful of finding sufficient capital to form a new company to acquire and work the now abandoned South Tincroft and Carn Brea mines, in which he has great faith.

East Pool & Agar.—The result of the first year's working under the new regime was a loss of £453, which must be regarded as eminently satisfactory considering the large amount of preliminary work that was necessary to enable the management to reduce the working cost, and also the low value of the ore handled (20·31 shillings per ton.) The report of Bewick, Moreing & Co., the general managers, is the most complete and the most intelligible one I can recall being issued by a Cornish mining company, and I hope it may have the effect of imbuing other companies with a desire to give equally frank and intelligible information to their shareholders. In the past, managers of Cornish mines have been loth to make public the results of their investigations into particular matters, although publicity could have done them no harm and would have benefited the industry.

During the year, 68,216 tons of ore was crushed by eight Holman stamps, the average duty per 24 hours being 25·8 tons. In this connection, it is interesting to learn that the installation of a new mortar-box designed by Mr. W. J. Loring has had the effect of raising the capacity of one stamp to over 40 tons per day. When the whole battery is similarly equipped the management anticipate being able to treat 10,000 tons of ore per month, which will mean a substantial reduction in the operating cost. The yield per ton is given in the subjoined table.

	Tons	Value £	Average price per ton £	Yield per ton milled Lb.	Yield per ton milled Shillings
Black Tin ...	528·5	62,176	117·63	17·35	18·23
Wolfram ...	45·5	5,036	110·57	1·49	1·48
Arsenic ...	238·5	1,965	8·24	7·83	·57
Copper ...	20	100	5·00	·65	·03
		£69277		27·32	20·31

The average chemical assay of the ore milled was 15·07 lb. metallic tin per ton, and the average assay of the tailing from the same 4·19 lb. The theoretical extraction was 72·1% as compared with an actual extraction of 72·8%. It will be noted that wolfram is now an important source of revenue. A second Humboldt-Wetherill magnetic separator has been installed.

The working cost was 20s. 6·27d. per ton. The development footage was 4187, at an average cost of 38s. 3d. per foot, and 2s. 4·23d. per ton of ore milled.

Attention is called to the irregularity of attendance on the part of the underground employees. It appears that no less than 23,780 shifts, or 76 per day on a basis of 313 working days in the year, were lost, and obviously this is fatal to effective and economical working. The matter is one that will have, sooner or later, to be seriously handled if working costs in Cornwall are to be reduced so as to enable the mines to be profitably worked with metallic tin at £160 per ton.

Levant.—This famous mine continues to be worked at a loss, the deficit on the 16 weeks ended February 14 last being £910. During this period 9053 tons of ore was milled, from which was produced 119 tons of black tin (or 29·4 lb. per ton) besides some copper and arsenic. The company has still in hand a sum of £5336, and it is fortunate that a proportion of the profit—made when the price of tin was high—was put aside, for otherwise the shareholders would have now had to meet the deficiency.

DISCUSSION

Ore.

The Editor:

Sir—In Mr. C. S. Herzig's recently published 'Mine Sampling and Valuing' the author very properly protests against restricting the definition of 'ore' to profitable material only. Mr. Herzig's remarks on this subject are quite to the point, and I am glad to see in Professor Kemp's letter to *The Mining Magazine* for February that he also recognizes certain advantages in the use of such phrases as 'pay-ore' and 'commercial ore.' As Mr. Thomas T. Read states in his letter to you, many of us "cannot agree that profit is a criterion in distinguishing ore from what is not ore."

'Pay-ore' and 'non-pay ore' or 'profitable ore' and 'non-profitable ore' are useful phrases; they are widely accepted among mining men and the public generally; they are sanctioned by usage; and until some better phrases are suggested and accepted, it seems to me that mining engineers are fully justified in continuing their use.

HAROLD ABBOT TITCOMB.

London, March 13.

Future of the Rand.

The Editor:

Sir—In your February editorial on the 'Future of the Rand' you critically compare the life estimates of the industry made by various engineers. These calculations run from 12 to 36 years from today, with an arithmetical average of 25 years. As the figures are largely based on the unreasonable assumption that the working cost of present high-grade (7 dwt.) operations will be carried into the period of final decline, the variations of estimate between 12 and 36 years do not seem astonishingly erratic.

You also quote, rather playfully, the estimate of the poor misguided Minister of Finance, who spoke of 50 or 60 years' life; and even mention the after-dinner speech of an ex-mayor of Johannesburg who ventured the belief that the field would be alive 70 or 80 years hence. Finally, you give a pertinent reference to the easily explained longevity of other threatened great mining fields, which—in accordance with natural laws—continue their records of production far beyond the apparent time limits set by the costly standards of ascendant activity.

In spite of the formidable character of the estimates with which you open your discussion, it is not surprising that you should qualify their significance with the opinion that "the funeral of the Witwatersrand is not likely to be attended by any of its present appraisers." Bearing in mind the mental and physical energy of the able young men associated with the recent Chamber of Mines' estimate, this prophecy means a minimum life of 40 to 45 years, let us say $42\frac{1}{2}$ years.

From the above considerations I conclude that in your opinion the true life of the Rand will be 70% in excess of the engineers' average estimate, only 23% short of the Minister's figure, and 43% short of the ambition of the Mayor, who would further have the benefit of the customary 10% for contingencies and the history of mining, from Camborne to Bendigo, in his favour.

Briefly, then, in your judgment upon the estimates before you, the politician carries an easy first, the ex-mayor second, and the engineers, as a body, a poor third.

The impartiality (and soundness) of your adjudication is to be warmly commended.

TWELVE-SHILLING-COSTS.

Superior, Wisconsin, March 14.

Antarctic Exploration.

The Editor:

Sir—The editorial on antarctic exploration in your January issue is, I believe, an unmerited attack on those who have rendered valuable service to science by exploration of the South Polar continent. The records of these explorations indicate that they have been typified by high scientific ideals. To characterize them as solely "grand stand plays" is, to say the least, unjust.

Through the efforts and self-sacrifice of the explorers of Antarctica enough is now known to warrant the hope that its geology can be deciphered, in spite of the fact that much of the bedrock is masked with ice and snow. Until the structure of this great continent has been determined, an important element in the study of the earth's history will be wanting.

The sweeping generalization in the editorial cited that " the poles were formerly tropical " is but a half-truth, and serves to emphasize the need of more information about the geology of the arctic provinces. The statement " We know the Poles were formerly tropical and the Tropics formerly glacial, but that geological fact is only astonishing to an ignoramus " might justifiably be considered an attack on all scientific research. If it were true, any other fact elucidating the history of the globe would likewise be only of histrionic value. I cannot believe that this view reflects the attitude of any considerable body of thinking men, for if it does there is little hope of advancing geologic science. If progress in geology is to be made, research must not be limited to the fields that give assurance of building up a " productive industry."

Among the important problems of geology are those connected with the occurrence of semi-tropical floras in the rocks of the Polar regions, and Antarctica seems to afford the best opportunity to study these problems. If there are men who are willing to investigate this difficult field, they should receive every encouragement to make their contributions to the advancement of geologic science, even though in the popular mind their achievements may become unduly magnified.

It is not safe to predict that this or that research will not benefit the material interests of mankind. It is a far cry from the coal-fields of Pennsylvania or Wales to the Polar regions, yet who can say that the clue to the genesis of fossil-fuels may not be found in Antarctica.

Turning to another phase of the editorial, no one can doubt that Sir Ernest Shackleton might obtain valuable economic results by applying his resources and energies to investigations of Northern Canada. This would, however, not advance geologic science as much as the proposed exploration of Antarctica ; Canadian geology is being exhaustively studied by Doctor Brock and his associates, while Noman's Land in the South Polar region will remain unknown but for the efforts of such organizations as the Shackleton expedition. If support for this important scientific work necessitates an appeal to the popular craving for heroics, even this fact may not be an unmixed evil in this day of pronounced commercialism.

ALFRED H. BROOKS.

Washington, March 11.

[There are two sides to most cases. This is the other side. We are glad to give space to Mr. Brooks, who himself has done some of the most useful exploratory work recorded in the annals of mining.—EDITOR].

Tuff and Tufa.

The Editor :

Sir—Referring to your editorial on 'Technical Spelling' in the February number, why not also bring up the case of 'tuff' for the volcanic rock and 'tufa' for the deposit of mineral springs ? This distinction has been proposed by Professor Kemp and is according to the Standard dictionary, but some other dictionaries give both spellings for the same materials, and many writers still use 'tufa' for the volcanic rock.

V. G. HILLS.

Denver, March 11.

Nomenclature of Faults.

The Editor :

Sir—Allow me to draw your attention to a report recently issued by the Geological Society of America, on the nomenclature of faults.*

Some clear understanding of the exact meaning of such terms as 'throw' and 'heave' has become necessary. The above-mentioned report says that these terms were first introduced in English coal-mines, the beds of which were flat and the faults dipped steeply. Applying the term to other and more inclined strata makes more precise definitions necessary. The term 'throw' is defined in the report as "the vertical distance between corresponding lines in the fracture surface of a disrupted stratum, etc., measured in a vertical plane at right angles to the fault strike." The term 'heave' is defined in the report as "the horizontal distance between corresponding lines in the two fracture surfaces of a disrupted stratum, etc., measured in a vertical plane at right angles to the fault strike."

Let us see if these definitions cannot be made lucid. Let it be understood that we are talking about a fault that has disrupted a rock-plane. Measuring along the dip, we obtain the distance between the disrupted edges of the rock-plane. This may be divided into a

* Bull. Geol. Soc. of Am., Vol. 24, 1913.

vertical component (the throw) and a single horizontal component (the heave). As a fault often has some thickness and no regular walls, such a definition is unsatisfactory. Would it not be better to call the 'throw' the vertical distance between the two parts of the disrupted plane, one of them produced if necessary. By the vertical distance between two parallel planes is of course always understood the least vertical distance.

Either of these definitions for 'throw' corresponds with the term as understood in the English coal mines. One measures the 'throw' from the indefinite and often contorted and disfigured disrupted edges; the other from the two portions of the plane as it occurs in the solid ground some little distance on each side of the fault.

The latter was chosen by me after serious consideration for the preparation of definitions for Hosmer & Breed's 'Principles of Surveying' several years ago. It simply records the net effect of the fault on the change of position of the bed or vein, without any reference to the actual strike or dip of the fault, which may be quite variable.

Another important measurement is what the report terms the 'offset.' This is defined in the report in a roundabout way, but evidently the committee mean that the 'offset' is the shortest horizontal distance between the two parts of the disrupted plane; one of them produced if necessary. Thus, suppose a miner is driving in a vein and strikes a fault; crosses it, and then runs a cross-cut at right angles to the drift until he catches the vein again; the length of the cross-cut, hanging wall to hanging wall or foot-wall, would be called the 'offset.' What the miner usually does, however, is to drive on the fault until he again finds the vein. The horizontal measurement along the fault is what I have elsewhere termed the 'heave,' and what I believe is intended in Geikie's 'Text-book of Geology.' It is hardly conceivable that either of the above definitions for 'heave' is what English coal-miners meant by the term.

I agree with Prof. Louis, who, in the discussion of the term 'pitch' as applied to ore-shoots before the American Institute of Mining Engineers, said that the ultimate test of the exact application of terms in measurement should be determined by their use and convenience in the surveying, plotting, and interpretation of the mine-plans. The definitions given in the report mentioned for the most part entirely fail to take account of the thickness of the fault; its rolls and variations of dip, or the amount of material rubbed and washed away from the walls; items that may make considerable difference. While thus assuming too simple a basis for practical application, the report is at the same time unnecessarily complex, a failure that no doubt led Prof. Lindgren astray when he essayed an abstract for his book on 'Mineral Deposits.'

In the classification of faults, there also seem to be some unsatisfactory features. For example: following common usage, a 'strike-fault' is defined as one whose strike is parallel to the strike of the strata. A 'dip-fault' is defined as one whose strike is approximately at right angles to the strike of the strata. The committee, however, introduces terms quite similar to these, to which it gives an entirely different meaning. It defines a "strike-dip fault" as one whose slip is practically in the direction of the fault-strike, and a "dip-slip fault" as one whose slip is practically in the direction of the fault-dip. Surely these two pairs of terms are too much alike for practical distinction. If any example of confusion is needed, it can be found in the report of the Society itself, where the term 'strike-fault' is twice used when 'strike-slip fault' is evidently meant.

The term 'dip-slip fault' seems to me to be quite unnecessary, for it is a term covering both a normal and a reversed fault. The term 'strike-slip fault,' however, refers to a quite common class of faults, for which there is no regularly understood name. Sir Archibald Geikie does not speak of them in his text-book. Jukes Browne calls them 'heaves,' presumably because their displacement is wholly a 'heave,' as the word is sometimes understood. Scott calls them horizontal faults, or "heave faults" for a similar reason. James Geikie calls them "transcurrent faults" or "transverse thrusts" for less obvious reasons. Elsewhere I have called them "side-thrust fissures" or faults, by analogy with over-thrust faults, seeing that they thrust the vein to one side instead of raising or lowering it. Suess has called dip-faults of this class "flaws." Any of these names strike me as being better than that of "strike-dip fault."

So far, my objections may, for the most part, be simply due to a difference of opinion. I cannot look in the same way at the numerous other names for the various accidental phases of faulting that have been laid down in the report; for I believe we should be far better off without any of these names. The weakness of the pure geologist for coining new and bad names is proverbial; would there were some punishment for these offenders, such as is applied to those who issue bad money.

Suppose some leading mining society should do a similar thing; for example, supposing it laid down the law that the distance between two levels measured along the dip should be called the 'lev'; that the vertical distance between levels should be called the 'vertical lev'; that the horizontal or plan distance between levels should be called the 'horizontal lev,' and so on for the distances between rises and all its phases and similarly for stopes and mill-holes. I tremble to think of what would happen to that report or the committee that prepared it, and what would be the consequent proceedings of that Society.

Remembering what befell the ammonites (I mean, of course, the fossil ammonites) we may one day expect to be classified by the post-historic geologist as quite a different kind of animal if we happen to have a square instead of a round jaw. The big heads will also be a separate sub-species from the little heads. But just imagine the library of those days, when for millions of years the two or three annual books on the nomenclature of igneous rocks have been regularly contributed, each with its few thousand new terms all fittingly divided into rangs and sub-rangs. Speaking seriously, it behoves the pure geologists to be careful of introducing new names; the more so since the science is already so overburdened with redundant, ambiguous, and obsolete terms. In most cases it is entirely possible and satisfactory to refer to things by repeating the definition of them. I believe, that much to the detriment of geology, many of the best scientific minds give it a wide berth, for no other reason than its horrible confusion of terms.

I know, Mr. Editor, that you and most of your readers recognize the importance of having practical and precise language used in reports and descriptions of occurrences in and around mines. With exactly this motive, I submit the above.

BLAMEY STEVENS.

Mexico City, February 17.

The Institution.

The Editor:

Sir—After listening last night to the eloquent and dignified appeal of our worthy past-President for an increased number of subscribers to the Twenty-first Anniversary Fund, I felt possibly like many of our present politicians whose names need not be mentioned, since they belong to both parties—that "I had failed, miserably failed," in my obligations to our mother Institution. I determined that in spite of my limited means and by exercising some self-denial I should no longer remain among those who had so far failed to join what might aptly be called "the noble Six Hundred" of the Institution. I have much pleasure, therefore, in informing you that I have sent my cheque for two guineas to the fund, and seeing that there are, I believe, eighteen hundred members who have as yet not paid their quota and that some three thousand pounds or so is still required, I trust that, by publishing this letter, I may induce all of them to go and do likewise.

EDGAR P. RATHBONE.

London, March 27.

Ore.

The Editor:

Sir—It seems astonishing that such diversity of opinion could exist concerning the proper use of the word 'ore.' However, with characteristic perspicacity you, Sir, apparently thought otherwise; by promulgating your now famous dictum and having left it so freely open for discussion, you have thereby elicited the alarming fact of the existence of grave uncertainty as to the meaning of the little word. It is alarming because it affects a fundamental factor in a vast number of our professional deliberations and introduces an element of doubt that is not becoming among those who advise others on such important matters as come under our advisement.

It is our obvious duty to collaborate to set the matter right and come to some definite understanding in reference to what 'ore' should really be intended to mean, or to replace it by an expression to be used in order to let others know what we are thinking about when we are thinking about what we know they call 'ore.' In doing this it would be desirable to have the assent of all English-speaking communities concerned. It would perhaps mean on the part of some the relinquishing of individual proclivities, and, judging from some of the arguments adduced by yourself in support of your suggestion, it seems certain you would be willing to permit its modification to accord with any sound authoritative proposals like those made by various of your correspondents; provided there was adequate support in the form of a consensus of opinion or an approximation thereto.

At the outset is it not safe to assume that any definition of that calibre must have a quibblesome borderland, that it cannot be rogue- or fool-proof, that it will certainly be misused by some people symbolically or otherwise, and that it would be useless to endeavour to provide for these eccentricities? This would in no way prevent our definition being made as precise as is consistent with the useful purpose it is intended to serve. For example, it is difficult to see what beneficial purpose could be served by extending the meaning of the word to include classes of useful minerals already provided with distinctive, and generally accepted appellations and which have very different characters. Suggestions in this direction have been made by some of your correspondents; but is there not much harm in confusing things together by giving them the same name when they are not the same thing? And should this not be carefully avoided, and restriction of the meaning rather than extension of it be our aim? But always keeping in view the useful purpose the definition is to serve.

Your own suggestion, from this point of view, is distinctly on the right side as regards restriction and is, I think, admirable, as far as it goes. But would it serve the useful purpose we require? Does it not start (except in a comparatively small proportion of cases) too late in the economic career of the material upon which the metal-mining engineer and metal miner exert their energies in preparing it to attain the marketable state? And a name is required for that material upon which they direct their efforts to bring to that very stage of profit-earning; a stage that is affected by many more influences than time and place. Restricting the meaning as you suggest, Sir, would require another word to take the place of 'ore' as now generally used; although by the use of adjectives or adjectival phrases the word can be made to define precisely the material in the state to which your definition would restrict it. Moreover by similar means the word 'ore' can be used to describe intermediate stages easily and accurately, even down to waste ore; meaning material that a discerning man while throwing it aside unvalued perceives a possibility of its being of working value under conditions that, he may anticipate, would obtain within a future not too far removed.

Personally, I have observed the word used and have used it myself in a sense that has worked well and without any confusion whatever, which is to the effect that: Ores are mineral substances found in or on the earth's crust which are sought for and circumstances permitting worked for the value of the metal or metals they contain. It includes vast quantities of such mineral material that although of high value for their metal-content are without the pale of "metal-bearing rocks." It moreover provides that desideratum, a name that can be used for the material while it is still in the ground as well as throughout all the stages of its preparation for the market.

Except in cases where, for more or less philanthropic reasons, mines are worked at a loss, no mining engineer of standing would recommend clients to undertake an enterprise that he did not confidently expect would yield them an adequate return for their money. However, although a deposit of value for the metal contained therein might not at the time or at the place or at the time and place be saleable at a price above what it would cost to work it, yet on the above interpretation of the word the material of value for the metal it contained could still be distinguished by the word 'ore' from the rock that was not of value for the metal it contained or from rock which did not contain metal; even although circumstances were not favourable for its immediate working to produce material that could at once be sold for more than it cost to produce. Mining engineers have constantly to face this problem and it is their judgment which is exercised to decide whether or not such a deposit offers reasonable prospects of yielding material that will within reasonable time be able to be sold at a price above the cost of production.

By the use of the word 'ore' in the way set forth, any one of these positions could be easily explained to technical or non-technical clients; it is simply necessary to state that the deposit of ore does exist and that the conditions are such that it can be immediately worked to advantage; or that they are such that encourage working, although the advantage that would accrue would be delayed, or such that discourage working. I have, like others, I suppose, left blocks of ore untouched in a mine for the reason that samples taken have not indicated values that would yield sufficient return to cover the cost of mining and dressing; I never put any value on such ore but explain in the simple way just described that although it is ore and not rock, yet under prevailing conditions it is of no economic value. I venture to suggest that it would be highly satisfactory if the word 'ore' could be retained for the purpose for which it has been used so long but with precise restrictions.

D. A. LOUIS.

London, April 2.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

March 1914	Feb. 1914	March 1913.
£14. 8s. 1d.	£65. 8s. 5d.	£65. 8s. 9d.

The market during March has been unsteady, and prices have fluctuated between £63. 7s. 6d. and £66. 5s. for three months. The range of prices is not great, but the frequent change of tendency indicates that dealers are puzzled as to the ultimate developments. The reason for this hesitation is to be sought in the peculiar conditions revealed by the statistical aspect. Not only is there no slackening in the enormous shipments made to Europe of refined copper, but they are being made in increasing amount, and all previous records are left far behind by those registered for March. The market has not made up its mind as to the meaning of these shipments, and reports, to which the supposed trade decline gives colour, have been current of stocks being hidden on the Continent. Investigation has entirely failed to confirm these reports. The probability is that consumers, encouraged by the comparative cheapness of money, which they do not require for the business they are now actually doing, are taking the opportunity to acquire reserves of supplies at what must appear a low level. The prospects of trade are not discouraging, and fresh activity seems waiting upon a settlement of the various political and economic questions pending both at home and abroad.

TIN.

Average prices of cash standard tin:

March 1914	Feb. 1914	March 1913
£174. 0s. 1d.	£181. 12s. 0d.	£213. 11s. 10d.

We have had on the whole a reactionary market. Attempts by the bull party to lift prices have been frustrated, partly by the poor demand from America, and partly by depressing tactics on the eve of the Banca sale. The expectation of an improved market following the latter has been disappointed, although an average of £181 was realized at the sale, the bear raid having succeeded only too well. Eastern dealers seem unable to hold back their supplies any longer, and have been meeting demand more readily than was anticipated. The March figures were more favourable than dealers expected, but trade buying is reserved, as fresh orders for tinplates are slow. Importers have accordingly been unloading on the London market. The low price is attracting some outside speculation, especially from the Continent, but until America recovers from the doldrums a sustained improvement can scarcely begin.

LEAD.

Average prices of soft foreign lead:

March 1914	Feb. 1914	March 1913
£19. 2s. 3d.	£19. 2s. 8d.	£15. 19s. 8d.

Following a fairly strong market in the earlier part of the month, prices fell in the latter part with startling suddenness. The Russian demand has been persistent, but consumption in this country is greatly affected by the continued building strike. Added to this, American domestic lead has been pressed for sale on this side, and the sudden lowering of the New York price reacted drastically in London. The actual supply of metal does not justify the fall, but sentiment has been reversed, and dealers have been tumbling over each other in the endeavour to alter their books to suit the changed conditions. Hence lead, which had reached £19. 17s. 6d., was pressed for sale down to £17. 17s. 6d. At the low level quite a large business was done, and a recovery of fully 10s. has taken place.

SPELTER.

Average prices of good ordinary brands:

March 1914	Feb. 1914	March 1913
£21. 7s. 7d.	£21. 7s. 6d.	£24. 11s. 4d.

Trade has been gloomy. Consumers persistently remain out of the market and complain of lessened requirements. Expectations of their re-entering the market have been continually falsified. Prices remain steady. At the last syndicate meeting it was determined to make no change and to abolish the premium on forward delivery.

OTHER METALS AND MINERALS.

Prices quoted on April 8:

SILVER.—27d. per oz., standard.

PLATINUM.—185s. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£81 to £83 per ton.

NICKEL.—£170 per ton.

ANTIMONY.—£29 to £30 per ton.

ARSENIC, WHITE.—£13. 12s. 6d. per ton.

QUICKSILVER.—£7 per flask.

MANGANESE ORE.—8½d. to 10d. per unit.

IRON ORE. — Cumberland hematite 19s. per ton at mine. Spanish 18s. delivered.

PIG IRON.—Cleveland 51s. 6d. per ton. Hematite 61s. per ton.

WOLFRAM ORE.—33s. per unit (1%).

ROYAL SCHOOL OF MINES

Annual Dinner.—The 41st Old Students dinner and the first annual dinner of the R.S.M. Association took place on March 18th at the Café Monico. Professor William Gowland, A.R.S.M., F.R.S., the first President of the Association, was in the chair. After the loyal toasts, Mr. H. W. Hughes submitted that of the Royal College of Science Old Students' Association, the president of which, Professor H. E. Armstrong, made suitable response. It was shown by the cordiality with which he was received that the R.C.S. and R.S.M. are no longer rivals but companions in misfortune as regards being amalgamated, consolidated, agglomerated, and smothered under the successive edicts of educational mandarins.

Mr. F. H. HAMILTON rose to propose the toast of the evening. He said: Mr. Chairman and gentlemen, when I was first asked to propose this toast I expressed what I felt, and still feel, my sense of the honour that had been done me, together with my surprise that my name should have been suggested for such a task. The answer was: "Well, we thought it might interest us to hear what you have to say, as you have employed a good many mining engineers, and been associated with a good many members of the Royal School of Mines." Gentlemen, I can satisfy that curiosity very briefly. Those who, as I am, are connected with the financial side of mining, are, I think, necessarily optimists, otherwise we should not be in the business. (Laughter). Like all optimists, we have a touch of imagination. You may, perhaps, have observed certain mining prospectuses which deserve to rank quite high in the realm of imaginative literature. (Laughter). Mining engineers are necessary to save us from other people and ourselves. It has been my good fortune to be associated with many members of the Royal School of Mines, and I may say at once that my attitude toward it is characterized by a sense of obligation and of gratitude. Now I think the first thing that strikes one is a sense of the vitality of your institution—a vitality which is, perhaps, not altogether confined to the professional sphere. Anyone who has read the newspapers of late must have come upon the names of members of the Royal School very often. I saw, for example, that in Peru a difficult political situation was solved, or created (I do not know which)—(laughter)—by Col. Oscar Benavides, one of your graduates. [Sir Thos. Holland: Our best football forward.] Well, his training was evidently of use to him when he drove out the President at the sword's point. I do not know what his future will be, but he has made a highly sporting beginning. Then the name of Mr. Creswell has loomed largely of late. You may differ from Mr. Creswell politically, as I daresay most of you do, and as I do profoundly, yet those who have known him here and in South Africa will not question the sincerity of his motives. (Hear, hear). That is saying a good deal because, in South Africa, people are apt to take rather pessimistic views of human nature and human motives. On personal grounds, therefore, I was delighted that he was able to address a meeting only last night, the more so as my own political endeavours in the Transvaal, many years ago, procured for me a rather longer rest cure than I had contemplated or desired in Pretoria gaol, and I am glad to know that Mr. Creswell has been more fortunate. (Laughter). Then it was only the other day we read of Mr. Laurence Hill, son of the late Alexander Hill, receiving a medal for distinguished heroism in connection with the accident at one of the Rio Tinto shafts. (Hear, hear). When we turn to the more professional sphere of your activities, and look at the list of your officers, we receive the same impression of activity. Your President, Prof. Gowland, informed me, as I came into the room, that out of the last 21 of these dinners he had attended 20, and I have no doubt he will attend the next 20. (Cheers and laughter). Your vice-President, Prof. William Frecheville, is as well known and widely respected in the City of London generally as he is in his profession. (Cheers). Of the next name, I can claim to speak with a certain amount of authority because it has been my great good fortune to be intimately associated with your second vice-President, Mr. E. T. McCarthy, ever since I have been in the City of London. (Cheers). I may say that, within the last 48 hours, I heard rather a fine compliment paid to him by a Scotsman —a very shrewd hard-headed and successful man, and, like most of his countrymen, very little disposed to take anyone or anything on trust. He said: "I have known Mr. McCarthy since 1886. I was the first to take him up country in the Malay States, and am very glad I did so, because he turned down a proposition which proved to be a rank swindle. If I saw his name on any document now I would not want to read it through, because I would take it on trust." (Cheers). I have known Mr. McCarthy for 14 years, and you cannot know him for that time without having a high admiration for his sober judgment, and for his brilliant technical qualifications, and having for him personally a regard which, as the years go by, deepens into affection. I pass over the other names and come to that of your hon. secretary, Mr. T. A. Rickard. (Cheers). Gentlemen, it is possible even for a diffident man to differ from Mr. Rickard, and having regard to the number of opinions he holds and the extreme clearness and vigour with which he expresses them, it would perhaps argue a certain measure of intellectual torpor if one did not occasionally differ from him. (Laughter). It is, however, certainly impossible not to admire the high ideals he has set himself to serve, the courage and sincerity which he brings to his task, and the service which he has rendered and is rendering to sound and clean mining all over the world. I have only instanced these names as a proof of the proposition that, so far as it is possible to diagnose the health of the Royal School of Mines from a consideration of its components, it must be judged to be sound and in a very flourishing condition indeed. But there is the converse question—what is the influence of the Royal School of Mines upon its members, and how do its tradition and training react upon the individual graduate and the individual student? It is, perhaps, a little presumptuous of me to ask such a question or attempt to answer it, but, at all events, up to a point, I submit that the indications are fairly clear. The Royal School of Mines is, after all, the principal training school in these islands so far as metalliferous mining is concerned. For between 60 and 70 years it has been sending out a stream of men all over the world, many holding important positions, and all in a more or less degree influencing and affecting public and professional opinion. I started by saying that I was an optimist, but I do not think my optimism misleads me when I say that there has been an unmistakable improvement of late years in mining methods and in mining practice, and the most potent factor in that improvement, I venture to say, is the public opinion within the mining profession itself—(hear, hear)—a public opinion which is today becoming crystallized into a standard of conduct and honour as high as that which obtains in any profession in the world. (Cheers.) I do not suggest that we are at the millennium, or that our friends, the Press critics, will wake up and find their occupation gone, but the fact that the improvement is there, and that the grosser forms of mining deception are almost a negligible quantity, is, I take it, certain. Apart from these grosser forms of transgression, what about the influence of the Royal School of Mines in producing the rarer virtues of intellectual courage and honesty? Perhaps here I am skating on extremely thin ice. Prof. Armstrong made a reference to Huxley. I belong to an epoch which, I suppose, almost seems geological to many of the younger men here—(laughter)—the mid-Victorian period, which is today remembered chiefly for its furniture, which was hideous, and for some of its philosophies, which did not err on the side of excessive courage. I think such a generalization does injustice to a period which was really one of ferment and revolt against the principle of mere authority in almost every department of human thought, and I think if anyone were asked who were the leaders in that great and fruitful movement, perhaps the first names to occur to them would be those of two professors of the Royal School of Mines —Tyndall and Huxley. I never understood quite the connection of Huxley with mining. (Mr. Rickard: Paleontology!) Well, that conveys a certain impression to my mind! (Laughter). Whatever it may be, I am sure no Englishman in his generation, or any other for that matter, was better qualified to teach the supreme lesson that, whether you were confronted with a difficult mining proposition or a complex social question, or one of the profounder problems of existence, the thing that matters most is the habit of marshalling all the evidence and considering it exhaustively, carefully and judicially, and the courage which compels a man to say when he has come to a conclusion that he will not hesitate to proclaim it, or the courage, no less high, which impels him to say, "I do not know and I will not pretend that I do." (Cheers). That, gentlemen, was the lesson Huxley taught and which is today one of the spiritual inheritances of the Royal School of Mines. So long as the school preserves its identity (and long may it do it!), so long as that tradition is cherished, so long may we be sure that the Royal School of Mines will be in the future, as it has been in the past, the fruitful mother of active and worthy sons. (Cheers). Gentlemen, it is in the spirit of robust confidence that it will so continue that I propose to you "The Royal School of Mines," coupling with the toast the name of your distinguished President, Prof. Gowland. (Loud applause).

The toast was received with enthusiasm.

PROFESSOR GOWLAND acknowledged the toast and proceeded to say: It is just 21 years since it was my privilege to preside at the 20th dinner of the old Associates of the R.S.M. (Cheers). We were all then apprehensive as to the future of the School, but the clouds which threatened us then have had a silver lining, and at present our School is in an infinitely better position than at any previous period of its existence. (Hear, hear). Other clouds, however, more threatening than heretofore are appearing on the horizon. May they have not only a silver, but a golden lining. But of this more anon. I may now be permitted to say a few words regarding the origin and objects of this Association. To our friend and secretary, Mr. T. A. Rickard, the Association owes its origin. (Cheers). In his speech at the last dinner, he pointed out that for 40 years we had been content merely to dine together once a year, but that this, however praiseworthy it might be, left much to be desired, and, in fact, limited the scope of our usefulness to our School. The suggestions made in that speech met with general approval, and the organization of the Association was at once begun. As regards its objects I may say that they are:

To foster comradeship among the alumni.

To advance the interests of the R.S.M.

To express the opinion of those having its welfare at heart.

To aid young Associates in making a start, and give assistance to necessitous students of high character.

All these objects will, I am sure, commend themselves to you. (Hear, hear). Subscriptions and donations have come in freely, and the carrying out of them all is now well assured. (Cheers). A favourable opportunity presents itself tonight for bringing forward for the consideration of the members of our Association a very serious matter which threatens the Royal School of Mines, namely, the proposal on the part of the Government that the Imperial College, and with it the R.S.M., shall be incorporated with or absorbed by the London University. (Shouts of Never!). A letter from Mr. Pease, vice-President of the Board of Education, addressed to the vice-Chancellor of the University in November last, contains a statement of the intentions of the Government.

"It is an essential part of the scheme that the Imperial College should become a constituent college of the University under the educational and financial control of the Senate."

In a previous paragraph, he states that the control of the teaching and the examination of students in Colleges of the University shall be in the hands of the teachers. It is difficult to reconcile these statements, and the latter, I take it, may mean that only the manner of teaching and mode of examining is left to the teacher, but the subjects will be determined by the University. The supreme power to carry out the administration is to be given to a small Senate composed of lay persons, not representing any special interests. It is true, there is to be a Technological Committee of 15 persons, but the representatives upon it of the Governing body of the Imperial College are to be in a decided minority. It appears to me that the Royal Commission on University Education in London has assumed as an axiom that all teaching even of technological subjects must be carried out under an organization similar to that of the older universities, but, as my friend Sir Thomas Holland has aptly pointed out, "the constitution of these universities is not as seems to be commonly supposed the ingenious design of intellectually able men, but is merely the legacy of a gouty past." (Laughter). For pure science an academic training controlled by a university may be the best possible, but for the technical training necessary for men who have afterwards to be engaged in practical work as miners or metallurgists, it is the very worst. (Hear, hear). The control of such training, if it is to be efficient, should be in the hands of those who are, or have been actually engaged in the practice of, or are thoroughly conversant with, the needs of these two professions, and not in those of a mere academic body. No advantage of any kind would accrue to the R.S.M. by incorporation with the University, in fact, it is full of dangers of a very serious kind. (Hear, hear). The professional value of the A.R.S.M. is well and deservedly established throughout the whole world, and I think I am speaking without exaggeration when I say that there is absolutely no desire on the part of the great body of mining and metallurgical engineers for any university degree as a professional qualification. (Loud cheers). Now let us consider what has happened to King's College since its incorporation with the London University. For twenty years before its absorption, the training of engineers was carried out by a three or four years' course designed to give a sound engineering education. A diploma of Associateship of King's College or A.K.C. was awarded to successful students, and stamped them as good all-round engineers. Now that the College is incorporated with the University, the engineering students are not permitted to take the A.K.C. until they have first obtained a B.Sc. I am averse to prophesy, but I take it that if the Imperial College is incorporated with the University, one of the first results will be the abolishment of the A.R.S.M. and the substitution for it of the B.Sc., or the introduction of a regulation such as that enforced at King's College. Safeguards against this may be promised, but from my experience of safeguards, I fear they would only be of temporary value and would be set aside when an opportunity offered. As regards the proposed incorporation, I will read an important statement from the speech of Lord Crewe, Chairman of the Governing Body of the Imperial College, at the dinner of the Institution of Mining and Metallurgy:

"He had always been one of those who would have preferred that there should be created in London an altogether separate Technological University, unconnected with any body devoted to other branches of study. He had not arrived at that conclusion from a distaste for, or distrust of, the great University of London, to the excellence of whose work he bore testimony. His sentiment arose from the doubt which he had always entertained of the feasibility of combining in London on the enormous scale which such an institution must inevitably reach, the entire ambit of education —the complete encyclopædia, so to speak, of all kinds of human knowledge, of which a university had to be the representative. The one thing in their Imperial College they did feel entitled to claim, was that they should in some form or other maintain their complete independence as a college, both where the organization of studies was concerned, and also in matters of finance and in dealing with their own endowments."

If incorporation with the London University takes place, the R.S.M. will become a mere branch of the Faculty of Engineering and its individuality will be lost for ever. Our aim and duty should therefore be to oppose the scheme for our absorption, and do all that in our power lies to ensure that the Imperial College shall be left alone under our Rector, Sir Alfred Keogh (cheers) to carry out, without interference, the function for which it was established, the highest specialized instruction, in which it has had, and is having the greatest success. (Loud cheers).

A series of speeches entitled 'The Old Boys to the Young Boys' were delivered by Messrs. T. C. Cloud, Ben Howe, E. T. McCarthy, and T. Kirke Rose. These were a delightful feature of the evening in their humour, interest, and usefulness. Messrs. J. C. Allan and E. F. Newall made appropriate response in behalf of the 4th year students, of whom 25 were present, sandwiched between the older men, so as to promote acquaintance and goodwill. The students were guests of the Association, but each student was in the hospitable care of the 'old boy' on his left as regards drinks and smokes. The experiment proved an unquestioned success on both sides, and will become an honoured custom. It will fulfil one of the purposes of the Association, namely, "to promote solidarity" among the men of the R.S.M. We hope, and believe, that some of the acquaintances made at the dinner will have life-long value. The toast of the Chairman, proposed in felicitous terms by Mr. A. G. Charleton, was received with great enthusiasm. Professor Gowland responded, and then called on all present to join in singing Auld Lang Syne, which was done with vigour.

Lectures.—The idea of inviting practitioners from the outside to give occasional lectures at the Royal School of Mines is being developed most effectively. On February 16 Mr. Walter McDermott addressed the students on 'Some duties and difficulties of a mining engineer,' and it can readily be understood that he made it intensely interesting. On March 17 and 19 Mr. Newton B. Knox gave lectures on 'Alluvial Mining,' based on his experience in California and Colombia. On March 26 Mr. W. Fischer Wilkinson, recently principal of the Camborne School of Mines, explained the uses and applications of 'Ferro-Concrete.' We understand that later this year Mr. J. Mackintosh Bell will give a series of five lectures on economic geology, a subject on which he is peculiarly fitted to descant, having been Director of the Geological Survey of New Zealand, not to mention a wide experience in Canada and Siberia.

Presentation.—On March 31 Mr. L. H. Cooke, Assistant Professor of Mining and Instructor in Surveying, was presented with a gold watch, chain, and sovereign case as a tribute of affection and esteem from past and present students. The initiative in this graceful and appropriate act was taken by Mr. G. Percy Ashmore.

ACID-GAS FLOTATION.

By G. J. FROST.

MANY theories have been advanced concerning the formation of the 'sulphide froth' in flotation processes, but most of these seem to fail in application when the flotation agent in use is soluble in water.

If an ore consisting of blende in a quartzose gangue be agitated with water, it is at once apparent that the gangue becomes wetted and that for a time the blende remains dry.

The reason for this probably is that the water contains traces of CO_2 in solution, which acts as a weak acid upon the sulphide, producing a small quantity of sulphuretted hydrogen; this gas remains upon the surface of the blende particle, freeing it from contact with the water and causing it to remain dry. The presence of a small quantity of sulphuric acid in the water tends to aid this reaction, sulphuric acid being a much stronger acid than H_2CO_3. The presence of H_2S has been observed in a sulphide froth when sulphuric acid was used.

The quartz particle is unaffected by the acid, therefore no gas is evolved and the water can remain in contact with each particle.

The bubbles of H_2S so formed upon the blende particle are very small because the acidity of the water is only sufficient to produce — by momentary contact — a minute quantity of the gas that envelops the particle and thus prevents further action.

In certain instances, depending upon the size and shape of the particles, the gas produced is sufficient to render the particle of blende buoyant. In order to increase this buoyancy the pulp is aerated by mechanical agitation, and the bubbles of air driven through the pulp attach themselves to the gas film existent upon the blende particles, causing these to become buoyant and rise to the surface.

The gas-enveloped blende particle may be considered as a simple gas bubble, and when this is brought into contact with an air-bubble, the two bubbles readily coalesce, thus materially increasing the buoyancy of the particle.

The gas-enveloped particle rises to the surface of the liquid; upon reaching the meniscus the gas film breaks through the surface of the liquid; a fresh surface is formed in which is a depression, and in this depression rests the dry particle of blende. This operation is continued till eventually the original surface of the liquid is lost beneath a bulky sulphide froth.

On examining this froth it will be noticed that the mineral particles themselves are dry, but that 50 to 70% of the water is held up in the interstices between the gas bubbles that envelop the mineral particles.

The addition of a soluble frothing agent to the pulp increases the surface tension, augmenting the adhesion of the gas film to the blende particle. It will be noticed that all substances that are good frothing agents, such as eucalyptus, camphor, and pine-oils, contain a large proportion of matter soluble in water. When using eucalyptus oil (*eucalyptus amygdalina*) it is sometimes noticed that the froth contains a gummy or resinous substance; this seems to be due to oxidation of the oil. All essential oils undergo oxidation when exposed to light and air with the formation of divers resin-like compounds, the resinous matter so formed being held mechanically in the froth and in no way essential to the formation of this froth.

It is of interest to observe here the different behaviour of blende and galena when submitted to the flotation process. Should the foregoing theory be correct, then their relative resistance to the action of acid will be inversely proportional to their readiness to float. Practice shows that this order is maintained, and that the blende which is readily attacked by acid floats before the more resistent galena. Of course, it is hardly necessary to state that this is only true in the case where both minerals are more or less of the same degree of fineness; a small particle of galena will float as readily as a large particle of blende because the active area of the former is comparatively larger than that of the latter.

One of the processes in use for the separation of galena and blende depends upon the formation of a film of lead sulphate upon the surface of the galena, and then treating this product by the flotation process. By this method the galena is rendered inactive, the dilute acid solution having no action upon the lead sulphate that surrounds the galena particle, therefore no flotation of galena takes place, the blende however being unchanged by the sulphatizing operation and floats in the ordinary way.

It has been found that the presence of a small quantity of tannic acid in the water prevents flotation. If we consider that the oil, to be of use in flotation, must be in solution or in a fine state of emulsion practically equivalent to solution, then the action of tannic acid, which is a powerful coagulent and precipitant of organic matter, upon this solution is to cause precipitation of the oil and thereby render flotation impossible.

THE ZINC-CARBONATE ORES OF LEADVILLE.

Successive developments. Replacement of limestone by oxidation products. Siderite and Hydrozincite. Manganese ore. Significance of the discoveries.

By PHILIP ARGALL.

LEADVILLE, with a gross output of $400,000,000 from its gold, silver, lead, zinc, copper, manganese, and iron ores, has nevertheless had a checkered history, declining at times to a low level of production as certain minerals appeared to become exhausted or perhaps were too low-grade for profitable mining, and later, through discoveries of new deposits or a market-opening for ores not previously of commercial value, bursting forth again as Colorado's chief producer. The mineral sequence might roughly be classified as placer gold only in the early 'sixties; silver-lead carbonate ores in the 'seventies; silver-lead sulphide ores in the 'eighties; gold ores from veins and blanket deposits in the 'nineties; zinc sulphides in the first decade of this century, starting the second decade with zinc-carbonate ores. This means, of course, that while most of these various ores have been mined during the greater part of the 50 years, those indicated may be said to have furnished the principal sales during the decades noted, particularly gold after the silver panic of the early 'nineties and zinc carbonate during the last three years; the district adapting its output, as it were, to the changing conditions of the ore-market.

For the purpose of this paper a brief sketch of the geology is necessary to a clear understanding of the latest discovery: the long overlooked zinc-carbonate ore.

The lowest sedimentary is Cambrian quartzite resting on pre-Cambrian granite; this quartzite is about 150 ft. thick; then come:

Rock.	Period.	Thickness in. feet.
White limestone	Silurian	160
Parting quartzite	Devonian	30
Blue limestone	Lower Carboniferous	200
Weber shales and grits	Lower Carboniferous	2500

These formations are cut and intruded by numerous dikes and sheets of porphyry. The sheets are mostly parallel with the bedding, yet many of them cut across the beds; they vary from a few feet to one thousand feet in thickness; the thickest sheet is usually the White porphyry, a granite-porphyry intruded between the grits and the Blue limestone forming the roof of the so-called 'first contact.' The Grey porphyry is not unlike the White porphyry; it is often difficult to distinguish between them; it is, however, less silicious, darker in colour than the White, and forms the principal intrusions and dikes adjacent to the ore deposits in both limestones.

In the early days the great ore-shoot found in the Blue limestone immediately below the massive sheet of White porphyry was considered the only profitable deposit; later, huge orebodies were found in the Blue limestone and even in the White limestone in close connection with intrusive sheets of porphyry. Then came the designation 'first contact' deposit, 'second contact,' and, in some mines, 'third contact.' The White-porphyry Blue-limestone contact-plane, however, was considered the zone of chief mineralization and designated 'the contact' or the 'first contact.'

The monograph on Leadville, by Samuel Franklin Emmons, published in 1886, was of incalculable value to mine operators; it may be truthfully claimed as the foundation of economic geology applied to mining. Emmons showed that the porphyry intrusion occurred under 10,000 ft. of overlying rock, and that the ore deposits were metasomatic replacements of limestone under like condition, the intrusions resulting in a marked doming of the strata, followed by heavy step-faulting that brought the easterly dipping beds several times to the present surface after reaching considerable depth. The sequence may be summarized thus:

1. Intrusion of porphyry under 10,000 ft. of superincumbent strata.
2. Metasomatic deposition of the ores as sulphides.
3. Faulting and erosion that brought the primary ores within the region of surface agencies.
4. Oxidation of the sulphides, forming carbonates of lead, iron, manganese, and other oxides.

The outcrop of the silver-lead ores in the plane of the White-porphyry Blue-limestone contact showed everywhere oxidized ores; these, as followed downward in the contact-plane along a 15° to 20° dip, passed into mixed sulphide ores, pyrite, galena, and zinc-blende, with, in places, some copper sulphide, silver being always present in the ore and gold in certain localities only. The finding of deep ore deposits in the Blue limestone was not at first anticipated, but as development proceeded in the mines, many such bedded deposits were discovered not only in the

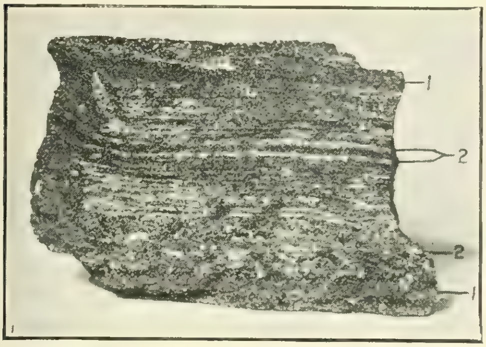


FIG. 1. LIMESTONE REPLACED BY ORE.

Blue but also in the White (Silurian) limestone, and even in the Cambrian quartzite, while fissure-veins have recently been worked in the underlying granite.

The genesis of the Leadville deposits has been widely discussed and is still a matter of dispute. Emmons believed the ores were formed by solutions coming from above, such solutions having derived their mineral content mainly from igneous rocks; he did not state that the solutions were derived from the eruptives in immediate contact with the ore deposits, or deny the possibility of their origin from profound depth. His final conclusions are thus stated*:

> "With regard to the immediate source from which the minerals forming these deposits were derived, the following conclusions have been arrived at:
>
> (1) That they came from above.
>
> (2) That they were derived mainly from the neighbouring eruptive rocks.
>
> By these statements it is not intended to deny the possibility that the material may originally have come from great depths, nor to maintain that they were necessarily derived entirely from eruptive rocks at present immediately in contact with the deposits."

Others claimed that all the ores ascended through fissures in the underlying granite. Emmons' qualifying distinctions were soon lost sight of; his statement that the ore-bearing solutions "came from above" was understood as meaning that they came out of the White porphyry. Thus schools of ascension and descension were formed. Lastly, certain foreign critics who had not seen the Leadville ore deposits, cast doubt on metasomatic replacement over such wide areas and advanced the hypothesis of the ores having filled pre-existing cavities.

A discussion on the genesis of the ores is outside the province of this paper; suffice it to say that in deposits of such area and complexity no one process could possibly suffice; furthermore, there is ample proof in the Leadville mines today of ore deposition by ascending solutions, by descending solutions, and by the filling of solution-cavities; these latter, however, are in the quartzite.

It is beyond question that the primary ore-bodies are due to replacement of limestone by sulphide ore, and I believe it is equally clear that further replacement of limestone—as zinc, iron, and manganese carbonates—by the oxidation products derived from the primary sulphides has taken place on a large scale: a condition of ore formation that, so far as I know, has not previously been recognized by writers on the Leadville deposits; hence the facts on which I predicate my conclusions are now presented for consideration.

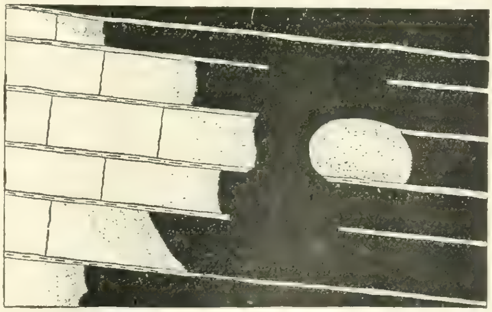


FIG. 2. EDGE OF ORE-SHOOT IN LIMESTONE.

The sulphide deposits in the Blue limestone occasionally show well marked bedding-planes and at rare intervals fine lamellar structure. Fig. 1 is a photograph of the best replacement specimen I have seen from the Blue limestone formation: first, pyrite with some zinc-blende; second, galena, alternating in layers varying between $\frac{1}{4}$ to $\frac{1}{16}$th inch each. It is, however, to the thinner beds and better marked bedding-planes of the White limestone that a study of metasomatic replacement should be referred in order to see the condition, not only of the sulphide replacement but also zinc-carbonate replacement itself.

Fig. 2, after George O. Argall, shows the

* Monograph XII., U.S. Geol. Survey, 1886. Page 379.

edge of a sulphide deposit in the White limestone of the Tucson mine. The unreplaced clay seams separating the beds average about half an inch thick, and are clearly marked throughout the orebody. In the Maid of Erin claim on Carbonate hill, the White limestone in places has been replaced by mixed zinc, iron, and manganese carbonates, practically from the Parting quartzite to the Cambrian quartzite, but the structural features in the upper portions of this deposit are now largely obliterated by further oxidation through which the ferrous iron is changed to ferric and the manganese minerals to the higher oxides. These mixed oxides deeply stain the ore deposit, while their partial removal in solution and precipitation elsewhere, no doubt, in greater part accounts for the loose shrunken condition in which the upper beds of zinc-carbonate ores now occur ; it also accounts for the 'black iron' deposits in greater part surrounding the smithsonite* ores at this horizon.

In the lower beds of the White limestone, however, the key to the situation is found. Last September, I observed on my first visit to the Maid of Erin property, a small fissure in the lower beds of the White limestone, not over 3 inches wide, its sides lined with botryoidal crusts of hydrozincite and the limestone replaced by zinc carbonate, quite rich in zinc near the fissure, but fading away in richness or giving place to siderite as it was followed outward from the fissure. Three samples showed the following :

Sample.	No. 1. %	No. 2. %	No. 3. %
Zinc	43·6	37·6	8·2
Iron	1·6	7·4	22·0
Manganese	3·4	6·1	18·0
Insoluble	2·3	4·6	11·6

No. 1 was chipped off the sides of the fissure.

No. 2 is cellular zinc carbonate about one foot from the fissure.

No. 3 was taken about 6 ft. from the fissure, where siderite showed strong ; a test for lime gave only a trace, showing complete replacement of the limestone by the mixed carbonates.

There has been much crimination and recrimination between mining engineers, geologists, and metallurgists, for not sooner recognizing the Leadville oxidized zinc ores. The reason is easily explained : but little exploration work was extended into the limestone below the oxidized lead deposits, and no mining, as far as I know, was done in the White limestone where light-coloured zinc, iron, and manganese carbonates are now clearly visible as replacement deposits, impossible to overlook.

It is said that some drifts passed through bodies of iron and manganese oxides exposing zinc carbonate ores heavily stained with these oxides; hence they were difficult to recognize, and, as previously noted, they remained for many years in sight without being recognized either by the mine operators or the casual visitor, however distinguished. After examining the upper oxidized zinc deposits last autumn, I felt strongly that it was only the limited number of visitors received at the Maid and Henriette mines that prevented the list of those who examined certain workings without detecting the exposed oxidized zinc ores being much longer that it is.

The bulk of the Leadville oxidized zinc ore is smithsonite (zinc carbonate) ; calamine (hydrated silicate of zinc) appears next in abundance, occurring as small veinlets cutting across the beds of smithsonite, occasionally as bunches of beautiful white crystals in cavities, lining druses and such like. It is probably the last mineral formed. Hydrozincite is found as a botryoidal crust lining cavities and fissures, covered in places with crystals of calamine, and as light-coloured earthy nodules and seams through the beds of smithsonite ore.

The smithsonite varies in colour from light-grey through all the medley of colour capable of being imparted to it by various iron, manganese, and other oxides. Near the main fissures or cavities it is usually cellular and always quite porous. Fig. 3 shows typical cellular smithsonite from a fissure-wall. A new mineral is reported as occurring in these zinc-carbonate deposits, namely, wolftonite, an oxide of manganese and zinc.

The following analysis of wolftonite (named after the Wolftone mine) was made by Mr. Beall, chemist for the Empire Zinc company, at Canon City, Colorado.

	%
Zn	29·8
Fe	trace
Insoluble	2·0
CaO	none
Sulphur	none
Mn	35·5
MgO	none
Al_2O_3	none
H_2O	4·7

From which the following composition is assumed :

	%
ZnO	37·1
MnO	19·4
MnO_2	32·4
Water	4·7
Insoluble	2·0

I find the zinc ore of maximum purity next

* In England the carbonate is called 'calamine' and the silicate 'smithsonite.' The distinction is important.—EDITOR.

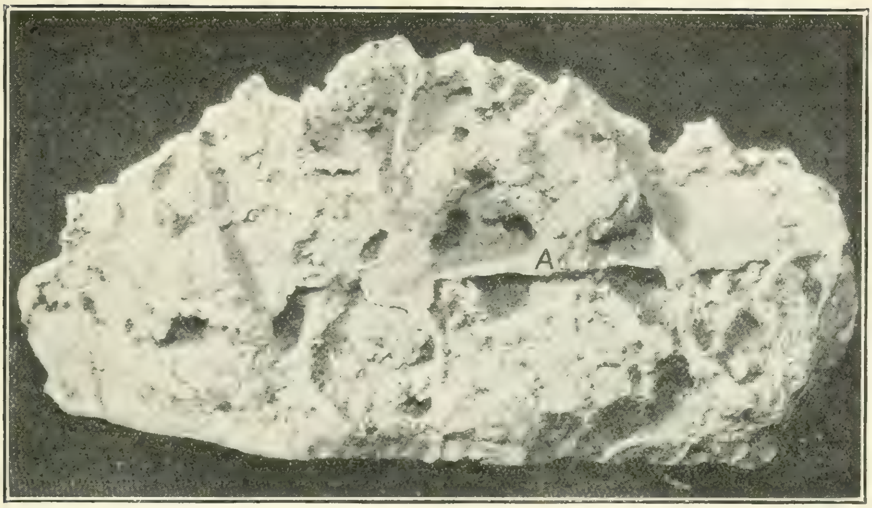


FIG. 3. CELLULAR ZINC CARBONATE.

the small fissures as examined in the lower beds of the White limestone of the Maid of Erin mine. Siderite, while perhaps present in all the zinc-carbonate ores, is inclined to occur in bunches or as the chief replacement of an entire limestone bed near the confines of the profitable limits of the zinc-carbonate ore. Almost every piece of grey unaltered smithsonite shows, on careful examination, crystals of galena, zinc-blende, and occasionally pyrite; galena being most common but always as included crystals. The long flat crystal-wall *A* on Fig. 3 shows a lamina of galena with one of smithsonite on either side; the sulphides mentioned are however more plentiful in and around siderite crystals.

Fig. 4 is hydrozincite covering quartzite, taken from the wall of a fissure; the covering is about ⅛ inch thick.

Fig. 5 shows a replacement deposit of zinc-carbonate ore in the Maid of Erin below an old sulphide stope; the stope is not now accessible, hence that portion of the sketch is diagrammatic.

The assays corresponding to the numbers on Fig. 5 follow:

	No. 1	No. 2	No. 3	No. 4	No 5	
Zinc......	34·2%	34·1%	23·2%	29·6%	18·4%	(A)
	No. 1	No. 2	No. 3	No. 4		
Zinc......	31·4%	26·8%	16·0%	5·1%	(B)	

These assays show that in the *A* bed the first six inches on either side of the fissure average 34·1% zinc, while at 18 in. from the fissure the average is 26·4% zinc, falling to 18·4% zinc at a distance of 3·6 in. (No. 5). The bed marked *B*, in which the fissure is quite small, gives for the first 6 inches on

FIG. 4. HYDROZINCITE COVERING QUARTZITE.

either side 29·1% zinc, falling to 16% zinc at a distance of 18 in. to the left, and 5% zinc at a similar distance to the right. The ore is practically all grey smithsonite mixed with manganiferous siderite, which increases irregularly in amount as the replacement extends from the fissure.

Fig. 6 shows what I take to be a typical smithsonite replacement deposit originating from a fissure ; this sketch represents the face of a stope in the bottom beds of the White limestone as of January 18 last. As the aim in mining is to break no ore below 18% zinc, very little of the lower-grade stuff was exposed in this working. The cavities in the vein will be noted, also the geode - like openings in the grey zinc-carbonate ; these latter are sometimes lined with hydrozincite, at other places with calamine ; in every case the ore around the geodes and circulation-cavities is high-grade smithsonite, quite porous and full of small passages ramifying through the beds ; these, however, become less numerous and apparently disappear when the zinc content becomes low. For two feet on either side of the fissure these ores will permit water to pass through them freely. Samples were taken across the beds in the position indicated on the sketch. The analysis follows. All the analyses are commercial ; following smelter practice, the metals are given as metallic, and lime as CaO :

Sample	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9
Zinc............	24·8	18·7	29·1	33·5	17·1	31·8	3·8	38·4	39·7
Iron	9·7	12·2	9·1	6·7	7·2	6·3	2·5	4·1	1·7
Manganese ...	6·2	8·2	6·9	5·4	8·1	4·9	1·8	3·9	0·8
Lime............	1·8	1·3	—	—	—	—	20·6	1·5	0·8
Insoluble......	13·2	22·8	13 2	12·6	34·4	15·6	20·6	4·8	13·4

No. 2 is low in zinc and high in ferrous iron and manganese ; it was taken where the bed showed much siderite and no visible pores, yet the replacement of the limestone is complete, as it appears to be in all places sampled excepting No. 7. No. 4 and 8 carry the highest zinc and lowest silica ; it will be observed that both these samples crossed small tube-like water-courses around which the ore is rich in zinc and extremely porous, consisting largely of cellular smithsonite, like Fig. 3. Assay No. 9 is smithsonite from the Kelly mine, at Magdalena, in New Mexico, for comparison ; it will be noted that the iron and manganese are much lower than in the Leadville ores.

The Kelly specimen is from a replacement of crystalline limestone (marble) and was found at the bottom of an oxidized chimney of cellular smithsonite and iron oxide, in which were hollow crystals of smithsonite of enormous size. At the bottom, however, oxidation had not taken place and the smithsonite appeared as a cream-coloured replacement, showing all the original structure of the limestone, with occasional crystals of zinc-blende, galena, and pyrite.

A peculiarity of the Magdalena ore deposits is the division of the crystalline limestone by a sheet of fine-grained limestone called the ' Silver pipe ' lime. The sulphide deposits occur in the crystalline limestone above or below the Silver pipe structure, but I have never seen the Silver pipe replaced by sulphides ; it has, however, been extensively replaced by the zinc carbonate and profitably mined for that ore over wide areas in the oxidized zone.

Sample No. 5 was taken in a fissure-cavity ; it was supposed to be hydrozincite, but proved to contain many fragments of quartz, hence the high silica content. No. 7 shows the distribution of metals in what I might describe as practically unreplaced limestone ; the high silica content is noteworthy. A composite sample of this smithsonite ore would run in round figures (excluding No. 7), zinc 27%, iron 8%, manganese 6%, silica (insoluble) 17% ; excluding No. 5, as an abnormally high silica, we reach an average silica content of 14%. We thus determine the ratio between iron and manganese in these secondary ores as 8 : 6. The Leadville sulphide ores are stated by Emmons to contain less than 2% manganese as a maximum and an average of about 1%. This statement* is no doubt correct regarding the sulphide shipped from the mines. The rejected low-grade ore and gangue usually contain considerable manganiferous siderite, certainly enough to raise the manganese content considerably above the higher limit stated above. Emmons and some of his critics have conjectured on the source of the manganese in the extensive deposits of ' black iron ' (mixed iron and manganese oxides) found in the plane of the ' first contact,' it being generally assumed that the primary sulphides of this horizon do not carry sufficient manganese to account for the manganiferous ores or ' black iron.' The consensus of opinion appears to favour the overlying sheet of White porphyry as the source ;

* 'The Downton District of Leadville,' Bull. 320, U.S. Geol. Sur., 1907, Page 34.

Emmons himself favours that hypothesis, though not conceding that any extraneous additions of manganese have occurred.* I agree with that conclusion, believing that the manganese in the siderite and in the Blue limestone is ample to account for all the manganese found in the oxidized ores in question.

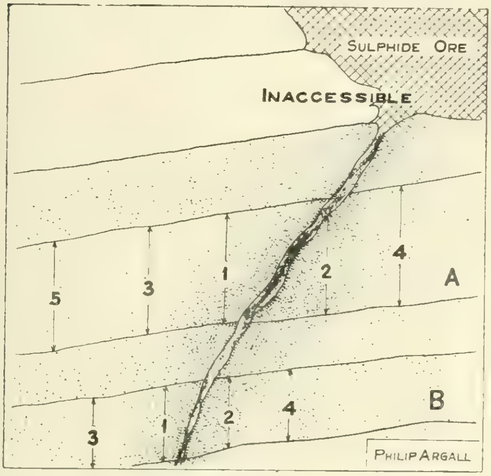


Fig. 5
Scale of Feet
1 0 1 2 3 4 5

The evidence submitted in this paper shows abundance of siderite as a replacement deposit in connection with the zinc carbonate derived from the oxidation of the primary sulphide in the White limestone; and while I believe siderite is more plentiful in the White limestone primary sulphides than in the same class of deposits in the Blue limestone, yet I feel that the presence of siderite in the latter has not been given due significance by previous writers, nor has the Blue limestone itself been given as a source of manganese, though known to contain a considerable proportion of that element.

I have studied replacement deposits of smithsonite in the limestone of New Mexico and elsewhere, and found conditions not unlike those described in the Maid of Erin, where the oxidation of mixed sulphides has, in the same formation, resulted in replacement deposits of zinc, iron, and manganese carbonates and silicates at a lower level in the limestone easily traced from solid unaltered carbonate to loose or granular mixed oxides at a higher level.

I have described the small replacement deposits from fissures solely for the reason that the mixed carbonates were apparently unaltered at the places chosen for sampling and description; at least, the various minerals were easily distinguished as they were entirely uncoloured by oxidation products. Passing upward from these deep deposits of unaltered carbonates, one can trace clearly the gradation of oxidation in the series of beds, once no doubt entirely replaced by mixed carbonate similar to the fissure deposit, but consisting now of loose layers of smithsonite, heavily stained with iron and manganese oxides and in places seamed with veinlets of calamine; these oxides predominating here and there, and more particularly toward the outer edges of the deposit where workable beds of 'black iron' occur similar to those of the 'first contact' Blue limestone deposit.

Oxidation of the sulphides in the Blue limestone followed doubtless the same general lines as those just traced for like deposits in the White limestone, and to such action I attribute the formation of the 'black iron' deposits of the 'first contact.' In the latter, however, the presumably greater amount of circulating water during the oxidation period would tend toward the removal of more zinc in solution and the formation of larger deposits of 'black iron.' The extent of the Leadville smithsonite deposits is not yet known

Fig. 6
Scale of Feet
1 0 1 2 3 4 5

with certainty. So far the highly fissured beds below the great stopes of lead carbonate (long since exhausted and abandoned) on Carbonate hill have furnished the chief production. Smaller deposits have been opened in many other places in the district below the old

* Bull. 320, U.S. Geol. Sur., 1907. Page 35.

lead stopes of the early days, and it is to such localities, near the faults and fissures, that further deposits may be found.

The significance of these smithsonite deposits is perhaps best shown by the production of Carbonate hill alone, the largest deposit so far opened, which began in 1910 with 4500 tons, containing 2,382,191 lb. of zinc, reaching a production for the year 1913 of 108,000 tons and a total output of smithsonite ores to the close of 1913 amounting to 318,600 tons, containing 187,100,000 lb. of zinc.

THE TECHNICAL LIBRARIES OF LONDON.

By EDGAR P. RATHBONE.

IT is estimated that there are in the various technical libraries in London no less than 750,000 volumes. Theology, law, and medicine come second with about 275,000 each ; and then economics with about 250,000 volumes. These particulars are given in an excellent little work entitled 'The Libraries of London,' prepared on the instruction of the Senate of the University of London, by Reginald Arthur Rye, and published by the University of London, South Kensington, in 1908. The library of the British Museum is the largest in the world, the number of volumes being estimated at between four and five million, the Bibliothèque Nationale having over three million. Other public libraries total about one and a half million volumes, and an additional one million volumes are available in semi-public libraries for the free use of all real students.

Probably the most important library in London for technical readers is that known as the Patent Office Library, 25 Southampton Buildings, Chancery Lane, W.C., which is open to the public from 10 a.m. to 10 p.m. In this library there are about 105,000 volumes, and, in addition, a large collection of journals, transactions of societies, and text-books relating to the applied sciences and the arts. The books are arranged in bays on three floors, according to a minutely divided system of classification, and can be consulted without the formality of tickets. Guides to the various sections of the library can be purchased at 6d. each ; and the chief librarian and his assistants are always most courteous and obliging, doing everything in their power to help an inquirer.

Of other technical libraries in London that are particularly adapted to the wants of inquirers connected with the professions of mining and metallurgy, first and foremost is that of the Institution of Mining & Metallurgy, at 1 Finsbury Circus, E.C. There are, I am informed, about 4000 works in this library, and, in addition, the volumes of the transactions of various technical institutions. The Library is steadily acquiring a most useful index reference system, divided as to subject-matter, authors, and geographical. The subject-matter indexes are interesting, and a few examples may be given. Thus :

COPPER is divided as to *Geological*; *Geographical* : Europe, Asia, Africa, America, Australia; *Prospecting*; *Assaying and Analysis* : Sampling, General Assaying, Electro-Analysis ; *Milling and Concentration* : Milling, Concentration, Concentrating Mills ; *Roasting* ; *Sintering* ; *Smelting* : Blast Furnaces, Pyritic Smelting, Matte, Matte Smelting, Reverberatory Furnaces, Dust Treatment, Slags, Electric Smelting, General, Plant, Geographical ; *Converters and Converting* ; *Leaching* ; *Precipitation* ; *Electrolytic Treatment*; *General Treatment*; *Alloys* ; *Economics* ; *Various*.

Of the other technical libraries having special connection with mining, metallurgy, and engineering, the following may be mentioned : Institution of Civil Engineers, 45,000 volumes, inclusive of 810 volumes in which are found 15,000 pamphlets; Institution of Mechanical Engineers, 15,000 volumes; Institution of Electrical Engineers, 11,000 volumes; Iron and Steel Institute, 8000 volumes; Society of Engineers, 2600 volumes; Civil and Mechanical Engineers' Society, 200 volumes; Institution of Mining Engineers, 2100 volumes; Geological Society of London, 26,000 volumes ; Geological Survey and Museum of Practical Geology, 20,000 volumes; Royal Geographical Society, 45,000 volumes ; Faraday House, 700 volumes; London Mathematical Society, 3000 volumes ; Institute of Chemistry of Great Britain and Ireland, 2000 volumes; Chemical Society, 20,000 volumes and 4000 pamphlets ; Royal Colonial Institute (especially referring to the Colonies), 100,000 volumes ; Guildhall Library, 134,712 printed works and pamphlets, and 5816 manuscripts; Imperial Institute, 10,000 volumes ; Victoria and Albert Museum, South Kensington, 90,000 volumes; and the Royal Society, 80,000 volumes, consisting mainly of serial scientific publications from all parts of the world. Nearly all these libraries are available for the examination of books by the engineer, either being open to the public, or by introduction of a member of the particular institution.

STRIPPING FROZEN GRAVEL.

Thawing the Arctic overburden covering alluvial deposits in the North.

By E. E. McCARTHY.

IN the following article it is assumed that readers of technical journals are familiar with the gold-bearing gravel deposits of the North, and with the covering of 'muck' and moss that almost invariably accompanies such deposits. Reference is made to the literature of the subject and to the excellent descriptions by Mr. T. A. Rickard, and other writers, of the frozen gravel and its top covering. Where the term 'muck' is used in this paper it refers to a frozen substance having the following physical characteristics: colour, grey to black; composed of organic matter, particles of sand and silt, cemented by ice. In hardness it may be likened to a soft sandstone. The temperature of the frozen muck varies between 19° and 24° F., or 8 to 13 degrees below the freezing point. The average physical characteristics are:

Specific Gravity	1·392
Specific Heat	0·192
Weight of one cubic foot	87 lb.
Weight of solids in one cubic foot	49·33 lb.
Volume of solids in one cubic foot	31·9%

The figures are taken from a number of experiments made in 1912 by engineers in the employ of the Yukon Gold company.

The weight of the frozen gravel, per cubic foot, has been found from the average of a number of experiments to be 137·3 lb.; of which 17·4 lb. is ice and 119·9 lb. solid. The temperature varies between 18° and 22° F., averaging 19°. At one place, where it was possible to get a reading 38 ft. below the surface, a temperature of 2° was recorded. The temperature of the frozen bedrock varies between 8° and 14°, averaging $11\frac{1}{2}$ degrees.

A tract of creek ground of an extent sufficient to warrant the installation of a dredge will exhibit several, if not all, of the following characteristics:

1. Areas frozen to within a few feet of bedrock; the bottom gravel and bedrock being thawed naturally.
2. Areas thawed to within a few feet of bedrock and the remainder frozen.
3. Areas containing small irregular blocks of ground variously frozen and thawed.
4. Areas wholly frozen.
5. Areas wholly thawed.

The present method of removing the frost from the creek-gravel is the direct introduction of heat by means of steam. As against this method it is claimed that, by removing the insulating cover of frozen muck from the underlying gravel, the gravel and bedrock will thaw by exposure to the sun. At the statutory meeting of the North West Corporation, reported in the London *Statist* of December 6, 1913, the statement was made that 2,000,000 cubic yards had been "treated" at a cost of under 8 c. per cubic yard, meaning, presumedly, that this amount of gravel had been stripped of its overburden of muck, had been thawed, and is now ready for dredging. In this article, and also in the report of proceedings of the Granville Mining company, the further statement is made that the total estimated cost of thawing and dredging the gravel is 10 c. per cubic yard. This is compared to the Yukon Gold company's average cost of over 30 c. for doing the same work. It would, indeed, mark a new era in Klondyke dredging if such a cost for handling frozen gravel were capable of being reached.

The proposed method for preparing the gravel for dredging is not new. It has been tried, not only in the Klondyke but in the Forty Mile district and elsewhere in the North. The first step is to remove all the trees and brush on the property. It is then necessary to get rid of the covering of one to two feet of moss and vegetation that directly overlie the muck proper. This may be accomplished by plowing, burning, or removal by hand. The moss must be removed, as it will not float, and where it falls in the cuts and goes to the bottom, it prevents the further cutting action of the water on the muck and blocks the trenches. To get the best results, the course of the creek must be straightened to give it a maximum gradient. The creek-water is conducted to the point of operation by ditches situated on the rim of the creek, and then allowed to cut through the muck formation in a series of diagonal or cross ditches, or, in some instances, the entire creek is diverted into longitudinal ditches in the muck. These ditches are placed in a more or less regular manner, the distances apart depending upon local conditions. The cutting action of the water in the ditches may be somewhat hastened by using water under pressure through nozzles or 'giants.' A stream of water under pressure has little effect on the frozen muck itself, its value being in clearing the ditches of obstructions due to caving and sloughing, and in sweeping away the muck when thawed.

Frequently layers of fine sand are encountered in the muck deposit. These layers stop the cutting action of the water in the ditches. Where they are thick, mechanical means, such as plows and scrapers, must be employed.

After the property has been ribboned with ditches, varying from 6 to 15 ft. deep, it is necessary to remove the material between them. These ridges will thaw in time, and such portions as do thaw during the season may be moved by water under pressure. This process is continued until all the muck has been removed above the level of the creek-bed. In no case can muck be removed below the creek gradient. As the area stripped is widened, the grade of the cross-ditches decreases, the carrying power of the water diminishes, and more hand-labour is required.

An elaborate system of main ditches and laterals has to be constructed along the rim on either side of the valley to act as feeders for the small ditches that are cutting the muck. The construction of these main ditches and laterals is a costly item, and, due to their being largely in a muck formation, their maintenance is a source of continuous trouble and expense. When the stripping work is finished the ditches are useless, hence the entire construction and maintenance must be charged against the ground stripped.

An abundant supply of water is essential, if cheap stripping is to be done. The amount of water in the creeks during the flood season, or until the middle of May, is large, but cannot be used to any advantage for stripping on account of seasonal frost and difficulties of control, its only value being in flushing or clearing the material from the creek-channel. During the remainder of the season the amount of water in the average Klondyke creek will not exceed three 'sluice-heads,' or, approximately, 180 miner's inches, according to California measurement. Several samples were taken from points where work of this character was being conducted to get the maximum duty of the water. The average of these samples was as follows:

Specific gravity of solids	2·55
Solids carried by volume	2·41%
Solids carried by weight	6·2%

Assuming that this rate of work for the water could be maintained continuously throughout the season, which is altogether unlikely, the total amount of muck capable of being removed in a season would be 130,000 cubic yards, of which 41,600 cu. yd., approximately, would represent solid matter in suspension that would have to be removed. This is assuming an average water-flow for the season of 180 miner's inches, which is liberal for most Klondyke creeks, and also assuming that the water is used but once. It may be contended that, under a comprehensive stripping plan, the water may be used two or three times over, and that the duty given above would be doubled, or even quadrupled. Such a plan would involve the construction of settling-basins and some arrangement for flushing each basin, and, while possible, does not appear to be practicable, or within the limits of reasonable cost.

To approach the problem in another way, and as a check on the samples taken, we may assume the duty per miner's inch for the water used in removing the muck in the manner above described. Taking into account the flat grade, the fact that the water has to thaw a considerable proportion of the material as well as remove it, that the cross-ditches or sluices have a tendency to flatten, losing their depth, grade, or carrying capacity, it is reasonable to assume that the average duty per miner's inch would not be in excess of 4 cubic yards per inch in 24 hours. This is a high, rather than a low, estimate of what the water would actually accomplish in cutting down and carrying away this material. Using this figure for duty and taking the same average flow, we arrive at a total of material removed under average conditions, of 86,000 yards in a season. This figure is probably more nearly correct than that derived from samples representative of the best conditions.

Take a specific example of stripping the muck and preparing the gravel for a 7½ cu. ft. dredge, the size most used for creek-work. The capacity of such a dredge is 740,000 cu. yd. in a season of six months. Assume, as a typical case, a total depth of ground of 21 ft., depth of muck 9 ft. If the muck were stripped, the area worked by the dredge, handling gravel alone, would be 38·2 acres. The volume of frozen muck on this area, 9 ft. deep, is 555,000 yards. From data previously given, the volume of solids in a cubic yard of frozen muck will average 8·6 cu. ft. A total of 177,000 cu. yd. of solid material would have to be handled to uncover sufficient area to al-

Diverted Creek under-cutting bank of 'muck.'

Bank of 'muck' with moss covering.

low one dredge to operate one season. The total length of season during which stripping can be conducted to advantage is not over four months, or 120 days, approximately, and, during this time, the temperature at night will be below freezing point for at least six weeks. With the average flow of 180 miner's inches, and the maximum carrying capacity for the water, it would require 4·2 years to uncover enough ground to permit one $7\frac{1}{2}$ cu. ft. dredge to operate for one season.

Provided that additional water could be obtained, the grade and variable cross-section of the creek is still to be considered. The average gradient of a Klondyke creek is about 1%, but the grades vary widely from point to point. As the valley widens out, and particularly as the mouth is approached, the grade becomes flat and the velocity of the creek itself is low. Unless kept moving by artificial means, or by the addition of a water-supply to increase the velocity, the material carried in suspension will deposit when it reaches these flat portions, and the same material may have to be moved a number of times. Given sufficient water and grade to remove the muck, there would still remain large areas where the muck extends below the gradient of the creek-bed ; and areas where the muck has been covered by tailing from the workings of early days, and where ground-sluicing is difficult, if not altogether impracticable.

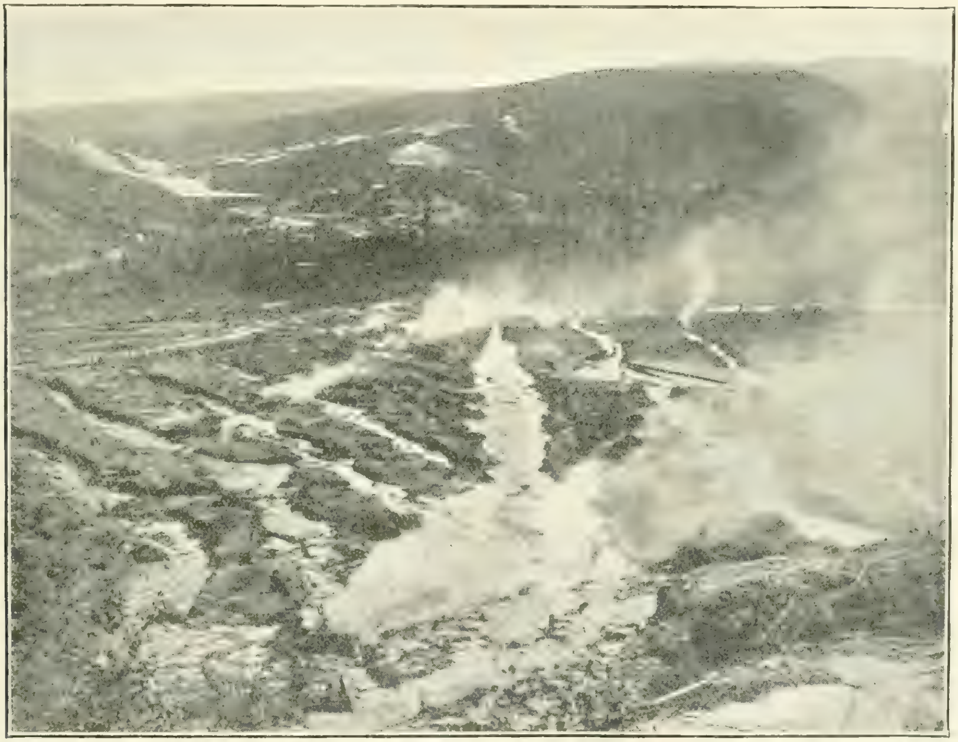
During the seasons of 1906, 1907, and 1909, the Yukon Gold company conducted some large-scale experiments with the removal of muck overburden. The tests were conducted at three different points on Bonanza creek, where every convenience was at hand. Two 5-in. giants under 400-ft. head were used at one point, and an additional supply of 3000 miner's inches was available on Bonanza creek after it had been used in the hydraulic mines. No trouble was experienced in getting rid of the muck in favourable localities, but the solid matter was deposited a short distance from the operation and had to be driven along. The serious drawbacks were that the muck extended below the gradient of the creek-channel in places, and that nothing could be done with the areas that were covered with a tailing of sand and gravel on top of the muck, within the limits of reasonable expense. As the cross-ditches cut down to a base-level they lost grade, and more and more hand-labour had to be employed. Buried roots and stumps had to be cut out by hand at great expense.

I have endeavoured to show that the stripping alone had its serious difficulties and that it cannot be accomplished with the ease and cheapness to be inferred from recent articles on this subject. We now approach the main question : Will the creek-gravel and bedrock thaw after the overburden is removed ? Is the method practicable and will it reduce the ultimate cost of dredging ?

The experiments of the Yukon Gold company, above described, were sufficient to demonstrate to our satisfaction that the method of stripping and so-called natural thawing could not be relied upon for any large-scale operation. The stripping work on claims No. 89 and 90 on Bonanza creek was of no benefit to the dredging operation. Practically all of the ground had to be thawed by steam before the dredges could operate. The ground was stripped and exposed for an average of less than a season before dredging was attempted. On claims No. 78 and 79 opposite Trail gulch, where main-ditch water was used for stripping, the ground was approximately 50% thawed when reached by the dredge a season and a half later. On account of incomplete data, it is not possible to say positively how much of the thaw was due to the stripping and how much of the ground was naturally thawed previously. It is my opinion, from the data available, that the proportion of complete thawing due to stripping was small and altogether disproportionate to the expense of doing the work. The same comments apply to the work on No. 62 and 63 Bonanza. In this case the stripping was more thorough and the ground was exposed for an average of over three seasons. The dredge reports show that 50% of the ground was frozen and had to be thawed by steam.

It is true that in almost all cases where there is an overburden of muck, the underlying gravel is frozen ; also, where areas of thawed ground have been found, there has been little or no overburden of muck. However, there are many areas free from muck that are frozen from immediately below the seasonal frost-line to bedrock. Evidence from thousands of bar and drill-holes seems to prove that the transition from the frozen to the thawed condition is gradual and in the form of a curve, and these curves always shape toward a drainage-channel. Although it cannot be said with certainty, all the data point to the conclusion that, unless the creek has an established drainage-channel to bedrock to carry the water from the melting of the ice in the frozen gravel, thawing will proceed with extreme slowness, and complete thawing will not result until such a channel is established.

The layers of muck sometimes found in the gravel, and the varying amount of clay that the gravels contain, rendering some more impervious than others, are important factors in the rate of thawing. The Yukon Gold company has carefully prospected practically all its properties for frost by means of Keystone drills and steel bars. From the data obtained coloured maps have been made showing the outline of the frozen, thawed, and partly thawed areas. To the eye the map of each creek looks like a crazy quilt. The only noticeable feature is that the thawed areas are almost invariably connected to a thawed bedrock-channel.



STRIPPING OPERATIONS ON CLAIM No. 88 BELOW BONANZA. CREEK IN CENTRE AND CROSS-DITCHES IN 'MUCK.'

Frozen gravel can only be thawed by absorbing heat. The amount of heat required is not small. A number of experiments made in 1912 showed that from 2470 to 3300 British thermal units are required to thaw one cubic foot of frozen gravel. This means an average of 78,000 B.T.U. per cubic yard. If the depth of gravel is taken at 5 yards, and we assume that this entire bed is to be thawed by exposure of the surface only, it is apparent that each superficial yard must absorb 390,000 B.T.U. before the thawing of 5 yards in depth is accomplished. When the relatively poor conductivity of gravel and sand is considered, it seems a strong assumption that this heat is to come from the sun and air without any drainage, percolating water, or outside help of any kind; and a particularly strong assumption when it is considered that the average summer temperature in the Klondyke district is not over 55° F.; that not more than two months of the entire year may be considered to be entirely free from frost; and that, for six months, the country is in the grasp of an Arctic winter.

Let me illustrate the requirements, if the Yukon Gold company used the so-called natural method of thawing. In the season of 1913, just closed, the dredges handled 5,133,000 cu. yd. of material. The ground averaged 24 ft. in depth with an average muck overburden of 6 ft. Of the area mined by the dredges, 68.5% was in a frozen condition and had to be thawed by steam before dredging. If the stripping method had been used the area stripped would have been 176 acres, the amount of muck moved would have been 1,711,000 cu. yd., containing 545,800 cu. yd. solid. To move this material in a season of 120 days would require the use of 2360 miner's inches daily at its maximum capacity. With the water actually available on the creeks last season it would take approximately 12 years to do the stripping work to provide enough ground for one season's operations. To thaw the gravel for one season's operations, when stripped, would require the enormous total of 274,256,000,000 B.T.U. It would seem that several seasons at least would be required to obtain this amouut of heat from exposure to the sun and air. The company is about to dredge, this season, an area of ground on Hunker creek that has practically no covering of muck. The gravel is thawed to a depth of 25 ft. from the surface. The remaining five feet of gravel and the bedrock are frozen. How much time would be required for the remainder to thaw ? Would operations have to be postponed for one season, or five, or ten ?

From an operating standpoint, considering the stripping as a working method, there are important considerations other than the rate of thawing. In the first place, to obtain any thawing results the exposure of the gravel must be nearly perfect. A few inches of muck in the thawed condition acts as an almost perfect insulator. It is not unusual to find in the Klondyke today masses of solid ice with only a few inches of thawed muck acting as a protecting cover. This makes it essential that the stripping, to be successful, must be clean, and that practically all the muck overburden must be removed. This is difficult, if not impossible, of accomplishment. In the event that it is decided to equip a property with a dredge before stripping is completed, it would be necessary to commence dredging operations at the upper end of the creek and work down-stream instead of up. Working down-stream is bad practice. Both the difficulties of operation and the cost are greatly increased. In the event that more than one dredge is to be installed on the same creek it would practically necessitate waiting until the stripping operation was completed before dredging operations could commence, otherwise the sediment would find a settling-basin in each dredge-pond along the creek. Assuming a property investment of considerable size, the interest charges alone would become a factor in the cost, to say nothing of the postponement of earnings indefinitely. Another difficulty that is generally overlooked where the stripping method is advanced, is the removal of the seasonal frost, which varies in depth in the creek-gravel, from 8 to 12 ft., in the naturally thawed areas. This frost must be extracted from the areas that are to be dredged between the dates of May 1 and June 15 by application of heat, or dredging postponed and the season shortened. In actual operation it has been necessary to use steam to thaw the seasonal frost as late as August. Fully a quarter of the area dredged each season will have to be thawed by the application of heat if a full season's operation is to be enjoyed.

In the statement in the *Statist* above quoted, the operations of the Canadian Klondyke Mining company in the Klondyke valley are cited, and the inference drawn that the creek-gravel when stripped will be capable of treatment at a cost as low as the estimated dredging cost of the same company, that is, 6 cents per cubic yard. The physical characteristics of the two deposits—creek and river—are entirely different and no comparison can properly be made between them that does not take into account these differences. The work of the Canadian Klondyke company has been confined to naturally thawed areas in the Klondyke valley, of irregular shape, extending along and in the river-channel and varying in width from a few hundred to over a thousand feet. The Klondyke is a large river that flows throughout the year. The gravel is large in size, rounded and well waterworn, and, where naturally thawed, is free and easy to excavate. The naturally thawed areas in the valley are connected by thawed river-channels and have an established drainage throughout the year. The underground flow and seepage appear to be responsible for the naturally thawed areas. The irregularity of these areas may be explained by the different character of the gravel, making it variously impervious to the percolation of water, also the different degrees of cold in the frozen gravel, the temperature of which has been found to vary between wide limits. It is unsafe, to say the least, to draw any deductions from the naturally thawed areas of the Klondyke river for sweeping application to the frozen gravel-beds of the Klondyke creeks.

In the same article the statement is made that the Canadian Klondyke company has "done away with the necessity of steam-thawing." This statement gives an altogether erroneous impression. The Canadian Klondyke company has not used steam-thawing in its work in the Klondyke valley, as the operation has been entirely confined to the naturally thawed areas. Where this company has undertaken creek-dredging, as was done last season on Hunker creek, steam-thawing was employed, the operation being practically identical with the thawing and dredging operation of the Yukon Gold company. Judging from observation of the work, it is safe to say that, instead of a cost of 10 c. per cubic yard, the dredging cost, including thawing, for the Hunker creek operation of the Canadian Klondyke company was not less than 30 c. per cubic yard, and probably in excess of this figure.

With the exception of the experiments on Bonanza creek, above described, no working test of the so-called natural thawing has been made in the Klondyke district, and no dredging operations are being conducted in ground that has been so prepared. At best the stripping operations on Dominion creek can, thus far, be considered as little more than laboratory experiments on a large scale, and no authoritative statement as to thawing results or ultimate cost can properly be made at the present time. It will require a much larger expenditure than has already been made, and many years in time, to demonstrate conclusively the success or failure of the stripping method. The data at present available all point to the conclusion that, for large-scale operations, the thawing results will be disappointing and the cost will exceed that of steam-thawing. The results thus far offer no inducement for abandoning the well tried method of thawing by steam for such an unproved method as the one described herein. The desire for some cheap thawing process to make the large areas of low-grade frozen gravel workable at a profit, and the wish that these areas could be cheaply thawed, seems to have been father to the thought that the problem has been satisfactorily solved.

Platinum.—The production of platinum in the Ural region of Russia during 1913 shows a considerable reduction as compared with 1912, according to the official report. The figures were 157,630 ounces of crude metal, which is usually assumed to be 83% fine. The figures during the last ten years are as follows :

1904	161,197	1909	164,513
1905	168,343	1910	176,020
1906	186,674	1911	185,529
1907	173,500	1912	177,515
1908	157,051	1913	157,630

It will be seen that the production for 1913 was the lowest during the decade, with the exception of the year 1908.

Copper Production.

Henry R. Merton & Co. have published a report on the production of copper throughout the world during the last 20 years. We quote the figures for the last 3 years as follows :

	1913 Long Tons	1912 Long Tons	1911 Long Tons
Africa—			
Katanga	6,790	2,345	1,000
Cape Co	3,220	3,870	4,480
Namaqua	2,500	2,500	2,500
Others	10,000	7,655	9,000
Total Africa	22,510	16,370	16,980
Argentina	115	330	1,020
Australasia	46,580	47,020	41,840
Austria	3,765	3,860	2,440
Bolivia	3,600	1,850	1,800
Canada	34,365	34,710	24,930
Chile	39,385	37,305	29,595
Cuba	3,365	4,325	3,695
England	*300	300	400
Germany—			
Mansfeld	19,980	20,180	20,520
Others	4,930	5,040	1,490
Hungary	305	100	85
Italy	1,600	2,300	2,600
Japan	72,000	65,500	55,000
Mexico—			
Boleo	12,795	12,450	12,165
Others	‡39,185	‡60,005	‡48,740
Newfoundland	—	540	1,155
Norway—			
Sulitelma	4,610	4,755	3,590
Others	7,000	6,225	5,835
Peru	25,310	26,065	28,050
Russia	38,240	33,010	25,310
Servia	6,275	7,240	6,885
Sweden	1,000	1,500	2,000
Spain & Portugal			
Rio Tinto	36,320	39,925	33,385
Tharsis	3,220	3,375	3,395
Mason & Barry	3,135	3,540	2,920
Sevilla	1,510	1,390	1,530
Others	9,650	10,700	9,700
Total S. & P.	53,835	58,930	50,930
United States—			
Calumet & H.	‡20,000	‡35,000	‡35,000
Other Lake	‡51,875	‡68,405	‡61,615
Montana	‡126,880	‡138,055	‡121,410
Arizona	‡179,115	‡159,800	‡134,185
Other States	‡170,705	‡153,100	‡131,655
Total U. S.	548,575	554,360	483,865
Turkey	500	500	1,000
Venezuela	1,250	1,340	—
	986,375	1,006,110	871,920
Average of Prices of Standard on the 1st of each month	£68. 5s. 9d.	£73. 1s. 3d.	£55. 16s. 2d.

* Estimated.

‡ As given by the *Engineering and Mining Journal*

QUOTATIONS

of leading mining shares on the London Market.
Shares are £1 par value except where otherwise noted.
Quotations are given in shillings.

GOLD, SILVER, DIAMONDS:	April 1 1913	Mar. 1 1914	April 1 1914
Rand:			
Bantjes	23	15	14
Brakpan	86	53	46
Central Mining (£12)	215	162	155
Cinderella	17	6	6
City & Suburban (£4)	47	42	48
City Deep	68	62	60
Consolidated Gold Fields	57	47	45
Consolidated Langlaagte	29	31	31
Consolidated Main Reef	19	18	18
Crown Mines (10s.)	143	126	120
Durban Roodepoort	20	17	17
D. Roodepoort Deep	23	17	17
East Rand Proprietary	58	40	37
Ferreira Deep	68	47	47
Geduld	22	25	24
Geldenhuis Deep	31	25	22
Heriot	76	52	52
Jupiter	10	5	5
Kleinfontein	22	25	24
Knight Central	12	11	10
Knight's Deep	42	32	31
Langlaagte Estates	28	18	18
Luipaard's Vlei	8	10	9
Main Reef West	17	8	7
Meyer & Charlton	108	106	105
Modderfontein B	77	81	78
Modderfontein, New (£4)	247	240	240
Nourse	38	33	31
Primrose	33	27	26
Rand Mines (5s.)	137	116	115
Randfontein Central	27	21	20
Robinson (£5)	67	52	53
Robinson Deep	38	28	27
Rose Deep	58	42	45
Simmer & Jack	15	11	10
Simmer Deep	2	2	2
Springs	17	15	13
Van Ryn	77	68	66
Van Ryn Deep	26	42	42
Village Deep	43	33	35
Village Main Reef	45	33	32
Witwatersrand (Knight's)	61	68	66
Witwatersrand Deep	53	52	51
Wolhuter	17	13	15
Rhodesia:			
Cam & Motor	36	25	25
Chartered	23	19	19
Eileen Alannah	11	12	12
Eldorado	29	18	17
Enterprise	14	13	11
Falcon	24	16	12
Giant	21	17	16
Globe & Phœnix (5s.)	29	37	35
Lonely Reef	57	38	32
Shamva	61	42	41
Wanderer (5s.)	2	2	2
Willoughby's (10s.)	11	9	8
Others in South Africa:			
De Beers (£2 10s.)	438	375	373
Glynn's Lydenburg	21	15	10
Jagersfontein	146	105	93
Premier Diamond (2s. 6d.)	242	188	177
Sheba (5s.)	5	5	5
Transvaal Gold Mining Estates	58	42	42
West Africa:			
Abbontiakoon (10s.)	7	7	7
Abosso	17	16	16
Ashanti (4s.)	23	17	16
Broomassie (10s.)	7	5	5
Prestea Block A	17	13	12
Taquah	17	17	16
West Australia:			
Associated Gold Mines	7	9	8
Associated Northern Blocks	20	7	7
Bullfinch	16	8	7
Golden Horse-Shoe (£5)	43	53	51
Great Boulder Proprietary (2s.)	11	14	14
Great Boulder Perseverance	2	3	2
Great Fingall	8	13	10
Ivanhoe (£5)	60	55	55
Kalgurli	41	37	37
Sons of Gwalia	19	24	23
Yuanmi	10	4	4

	April 1 1913	Mar. 1 1914	April 1 1914
Others in Australasia:			
Blackwater	22	18	17
Consolidated Gold Fields of N.Z.	13	18	17
Mount Boppy	17	12	13
Mount Morgan	67	63	62
Progress	6	14	12
Talisman	35	42	40
Tasmania Gold (10s.)	1	½	½
Waihi	30	57	45
Waihi Grand Junction	21	26	25
America:			
Alaska Treadwell (£5)	175	165	165
Buena Tierra	20	15	15
Butters Salvador	50	30	22
Camp Bird	20	12	12
Casey Cobalt	57	31	20
Cobalt Town Site	72	50	41
El Oro	16	14	14
Esperanza	30	18	17
Granville	13	10	10
Mexico Mines of El Oro	130	107	102
Oroville Dredging	7	12	13
St. John del Rey	16	16	16
Santa Gertrudis	26	17	15
Stratton's Independence (2s. 6d.)	2	½	½
Tomboy	26	23	22
Russia:			
Lena Goldfields	55	41	37
Orsk Priority	15	7	7
Siberian Proprietary	7	7	6
India:			
Champion Reef (2s. 6d.)	11	10	10
Mysore (10s.)	106	105	96
Nundydroog (10s.)	26	27	25
Ooregum (10s.)	22	23	23
COPPER:			
Anaconda (£5)	157	147	148
Arizona (5s.)	38	40	38
Cape Copper (£2)	130	80	72
Chillagoe (10s.)	½	¾	½
Cordoba (5s.)	7	6	6
Great Cobar (£5)	60	11	6
Great Fitzroy (5s.)	½	1	1
Hampden Cloncurry	42	32	32
Kyshtim	65	60	56
Messina (5s.)	20	33	31
Mount Elliott (£5)	120	76	73
Mount Lyell	24	25	26
Rio Tinto (£5)	1560	1400	1440
Sissert	25	31	27
South American Copper (2s.)	35	32	33
Spassky	82	62	56
Tanalyk	47	62	65
Tanganyika	47	42	41
Tharsis (£2)	150	137	140
Whim Well	20	8	7
LEAD-ZINC:			
Broken Hill:			
Amalgamated Zinc	34	28	28
British Broken Hill	37	42	41
Broken Hill Proprietary (8s.)	37	40	37
Broken Hill Block 10 (£10)	30	40	36
Broken Hill Block 14 (25s.)	8	7	7
Broken Hill North	43	57	53
Broken Hill South	142	172	173
Sulphide Corporation (15s.)	25	25	25
Zinc Corporation (10s.)	14	22	21
Russia:			
Russo-Asiatic	—	140	145
Russian Mining	10	38	35
TIN:			
Nigeria:			
Abu (5s.)	—	12	8
Bisichi	22	15	15
Jos (5s.)	9	8	7
Kaduna (5s.)	25	17	17
Naraguta	35	27	28
Nigerian Tin	26	17	17
N. Nigeria Bauchi (10s.)	5	5	5
Rayfield	20	9	8
Ropp	147	120	136
Other Countries:			
Aramayo Francke	32	36	36
Briseis	10	7	6
Cornwall Tailings	30	17	17
Dolcoath	20	14	13
Geevor (10s.)	16	7	7
Gopeng	30	28	32
Mawchi	26	25	25
Pahang Consolidated (5s.)	9	11	11
Renong Dredging	—	63	66
Rooiberg	36	26	25
Tekka	67	57	60
Tronoh	80	33	36

PRECIS OF TECHNOLOGY

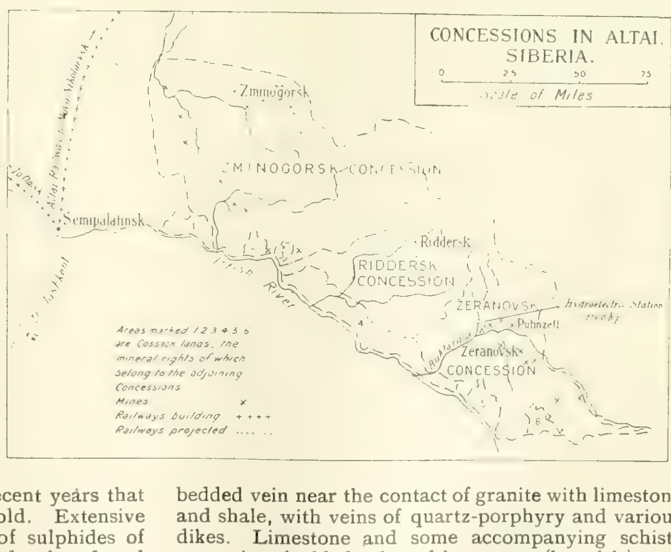
Mining in the Altai.—A pamphlet has been issued by the Russian Mining Corporation describing the country and the ore deposits included within the Thurn und Taxis concession in the Altai district of southwest Siberia. Our readers are aware that the Russo-Asiatic and the Russian Mining Corporations have acquired concessions in this region, the former having taken the Ridder, formerly part of the Thurn und Taxis concession, direct from the government, and the latter the Zminogorsk and Zeranovsk concessions, direct from Prince Alexander of Thurn und Taxis. In our February and March issues we gave information about the district and about the Ridder. The following information given by the Russian Mining deals chiefly with the Zminogorsk and Zeranovsk, but is of interest also from the general point of view.

The conditions are favourable for mining operations as regards population, water, timber, food supplies, horses, and cattle. The winter is severe, but does not necessarily interfere with regular working. After snow has fallen, communication is maintained with the Trans-Siberian railway at Novo-Nikolaevsk by means of sleighs, and the journey from Zminogorsk takes 7 days. During the summer, steamers ply on the Irtish river from Omsk to all the concessions. A new line, called the Altai railway, is in course of construction from Novo-Nikolaevsk to Barnaul and Semipalatinsk. It will pass within 75 miles from the Zminogorsk concession. The Kalchugina coal mines are on this route, and the railway will greatly facilitate the delivery of coal and coke to the mines. Water power suitable for the generation of electric current is available at several places. One installation of 1500 h.p. has already been erected in the Zeranovsk concession, but has been allowed to get into poor condition.

Some of the mines appear to have been worked in prehistoric times by the Tchuds. Records exist of work done since 1725. The mines were taken over by the imperial cabinet in 1747. The principal operations were on the silver-lead ores, and a large production was maintained until about 1861. Some copper was also produced, but it was not until recent years that serious attention was turned to the gold. Extensive deposits of complex ores consisting of sulphides of lead, zinc, copper, and iron have been developed, and it is these and the gold ores that will form the centre of activity in the near future. About 15 years ago, a Russian group, under French engineers, spent much money in development and machinery, but the project ended in failure. The three chief workings are the mines which give their names to the concessions. These three, though a long distance apart, are in one general line of occurrence, northwest and southeast, and their geological conditions appear to be almost identical. A great number of smaller mines and prospects occur in the same line, and there are a number of abandoned copper mines in a parallel belt nearer the Irtish river on the Zminogorsk concession.

The Zminogorsk is probably the oldest, and it was the most important mine in the Altai. It is at present being worked for its gold. A report was made on it in 1869 by Von Cotta. He described the deposit as a bedded vein near the contact of granite with limestone and shale, with veins of quartz-porphyry and various dikes. Limestone and some accompanying schists merge into bedded veins of hornstone (hornfels) near the contact. This hornstone carries gold in workable quantity. Overlying the hornstone are irregular veins of barite, which carry the silver-lead ores that were worked in earlier days. Von Cotta drew favourable conclusions as to the persistence of ore in depth from the fact of its great extent, the length being over 5½ miles. One barite body was 300 ft. long, varying from 50 to 250 ft. in thickness, and being worked to over

THE ALTAI DISTRICT OF SIBERIA.



HATCH'S GENETIC CLASSIFICATION OF ORE-DEPOSITS.

Nature of Deposit	Vehicle or Agent of Ore-Deposition					
	a Molten Magmas	*b* Gases and Vapours above their Critical Temperatures	*c* Deep-seated Waters whether of Magmatic or Meteoric Origin	*d* Vadose Waters	*e* Mechanical Agents, such as Moving Water and Wind	*f* Chemical and Bacterial Agents in Seas, Lakes and Swamps
1. Igneous Differentiates	Certain Massive Iron and Nickel Ores associated with Basic Igneous Intrusions (such as those of Sudbury)					
2. Cavity-Fillings	Injected Tin Ores (such as Tin Pegmatites and Tin Elvans on the Margin of Granite Intrusions)	Pneumatolytic Cavity-Fillings (such as Tin Quartz Veins)	Hydatogenetic Cavity-Fillings (many Fissure Veins)	Superficial Fracture-Fillings such as Gash-Veins in Limestones, and Cavity-Fillings such as the Hematites of Cumberland		
3. Metasomatic Replacements		Pneumatolytic Replacements, such as Tin Greisens and many Contact Deposits	Hydatogenetic Replacements (many Veins and Massive Deposits, also the Rand Banket)	Some Lead and Zinc-Ores in Limestones; Iron Ores replacing Limestones as in Cleveland; some Laterite Iron and Manganese Deposits; Secondary Enrichments of Copper Ores		
4. Stratified Deposits			Possibly some Sedimentary Deposits in which the Cementing Materials are Ores of the Metals	Some Lead and Copper Ores Interstitial in Sandstones and Shales	Mechanical Concentrates in Bedded Deposits such as Gold and Platinum Placers, Stream-Tin, Iron-Sands, Detrital Laterites and other Metalliferous Gravels and Sands	Chemical and Bacterial Sediments; for instance Lake and Bog Iron Ores; Clay-Ironstone, and other Sedimentary Siderites; Bog-Manganese Ore, and other Sedimentary Manganese Ores
5. Residual Deposits				Mantle-Deposits, such as Pisolitic and Nodular Ores of Iron (Bilbao and Appalachian Hematites and Limonites), of Manganese (Psilomelane) and of Aluminium (Bauxite)	Eluvial Gravels formed near the Outcrop of Veins, such as those of Gold, Cassiterite and Wolfram, Galena and Zinc Ore	

600 ft. in depth. More recent development has shown that the underlying hornstone carries finely-divided galena, blende, and iron and copper pyrite, with gold in profitable amount. It is reported that some of the gold ore has been treated by a simple extraction process for a yield of 8 to 10 dwt. per ton, but metallurgical difficulty arose with depth. At present a 15-stamp mill and an experimental cyanide plant are at work and the recovery has been improved. On the Zminogorsk belt about 25 mines have been opened at one time and another. From the records it appears certain that on the dumps and developed underground there must be large amounts of ore that would respond to modern methods.

The Zeranovsk group of mines is 150 miles southeast of Zminogorsk. Operations commenced in 1791, and by 1849, 10,000 tons of lead and 14 million ounces of silver had been produced. After 1850 the production increased for some years. Zeranovsk is an important mining centre, and at one time had a school of mines. The principal mine is extensively developed, and is in complex ores. Estimates made in 1904 gave 150,000 tons developed and 50,000 tons on the dumps. The ore was reported to average 22% zinc, 12% lead, 2% copper, 15 oz. silver, and 5 dwt. gold. The richer portions of the oxidized ore have all been extracted to a depth of 300 ft., but developments extend to 700 ft. deep. The ore in the upper workings appears to have been in the form of large lenses. It is reported that at the bottom of the mine there are two well-defined lodes, each 7 ft. thick and proved for 2000 ft. with ore at both ends. Occasionally branches of auriferous quartz are found. The country rock is a crystalline schist, and some ore-bearing hornstone also is found. In the Zeranovsk district there are other properties, some containing silver and gold and others copper. Of these mines, the Putinzeff and Buchtarminsk could easily be brought to a profitable stage of production. The metallurgical treatment of all these ores in the Altai will require careful study.

Classification of Ore Deposits.—In his presidential address before the Institution of Mining and Metallurgy, F. H. Hatch gave a classification of ore deposits, based on two principal lines of inquiry, one dealing with the agent or vehicle by which the metals have been collected, conveyed to, and deposited in the places where they are now found, and the other with the nature of the concentrates formed in the course of these processes. As regards the first, the agents or vehicles of concentration, there are; (*a*) molten magmas, (*b*) gases and vapours above their critical temperatures, (*c*) deep seated waters, whether of magmatic or of meteoric origin, (*d*) vadose waters, (*e*) mechanical agents such as moving water and wind, and (*f*) chemical and bacterial agents in lakes and seas. As regards the second, ore deposits are found to be: (1) igneous differentiates, (2) cavity-fillings, (3) metasomatic replacements, (4) stratified or sedimentary deposits, and (5) residual deposits. Of these, the sedimentary deposits comprise marine, lacustrine, and fluviatile accumulations, including placers.

It is possible by combining the facts elicited by these two lines of inquiry, to form a genetic scheme of classification. For example, cavity-filling may be due to igneous injection, to gases and vapours above their critical temperatures, to deep-seated waters, or to vadose waters. Again, metasomatic replacement may be brought about by gases and vapours, by deep-seated waters, or by vadose waters. By arranging these two series of relationships in vertical and horizontal columns, all the various types can be classified in the manner shown in the table on the opposite page.

Prevention of Malaria.—The *Rhodesian Mining Review* for February 18 contains the text of Surgeon-General W. G. Gorgas' report on malaria and blackwater fever in Rhodesia. The object of his visit was to study the sanitary conditions in the valleys in the neighbourhood of the railway north of Salisbury and down the Mazoe river. Here the population has suffered severely from malaria and blackwater fever. Mr. Gorgas states that the region is really a healthy agricultural district, and that, as drainage follows settlement, the scourge would gradually be removed without any special steps being taken. Nevertheless he urges the more rapid extinction of the mosquito both in Salisbury and in the country districts. Though the germ carried by the mosquito has been discovered in the case of malaria, and no germ has yet been identified in connection with blackwater and yellow fever, the same treatment has been found efficacious with the two latter as with the first named.

On several occasions we have referred to the suppression of the mosquito in unhealthy districts, but as many of our readers in various parts of the world are troubled with these adverse conditions, it will be helpful to quote liberally from Mr. Gorgas' Rhodesian report.

It has been proved that malaria is caused by a germ, which is transferred from one person to another by the female of the variety of mosquito known as anopheles. The female mosquito when several days old lays eggs in any convenient body of water such as a swamp, or a puddle, or in a cistern, a roof-gutter, or an old tin can. Each lay contains about 50 eggs. They hatch into larvæ in 1, 2, or 3 days, and after 8 or 9 days the larvæ develop into the full-grown mosquito. The ordinary food of the mosquito consists of vegetable juices, but the female requires blood in connection with ovulation. For this purpose she has a biting apparatus. When she bites a person suffering from malaria, she becomes infected with the germ. In 10 days time after biting her salivary glands contain the germ, and on her next visit for blood will infect a previously healthy person. With this knowledge of the life and habits of the germ and mosquito, it is comparatively easy to devise protective methods and to ultimately eradicate the fever in any locality. The most practicable is to destroy the larvæ, by draining the ground and removing all standing water within a distance of 200 yards from a habitation or community. This limit of 200 yards is adopted as being about the extent of a single flight of the mosquito. In case any of the water cannot be conveniently drained, paraffin can be poured over the surface. If a stream passes within this limit, some destructive chemical should be poured along the sides where the larvæ congregate. Naturally it is best whereever possible to build the dwellings on high and dry land away from streams or swamps.

The mosquito is liable to destruction by wind and by the direct rays of the sun, and for this reason she seeks the shelter of brushwood, houses, etc. It is advisable therefore to clear the ground of growth and of outhouses within 200 yards of the dwelling. It is necessary also to prevent the mosquito from obtaining access to the house by using wire-netting over the doors and windows and closing all crevices. In spite of all these precautions mosquitos will get in, and it is necessary to conduct killing campaigns against such. They hide about the house during the day, and with a little experience it is possible to find and kill them. It is notable also that the biting is almost invariably done at night, and a useful protection during sleeping hours can be obtained by a netting of canopy shape having no split and well leaded at the bottom. The use of quinine is effective in destroying the germ of malaria, and anyone taking 5 grains per day will always have some quinine in his blood sufficient to combat an injection by the mosquito. It is important to segregate persons suffering from malaria. In the case of natives it often happens that they may be extensively infected with the germ though showing no sign of illness. This is particularly the case with native children. It is important therefore to keep the native habitations at a distance from the living quarters of the whites.

Slides on the Panama Canal.—Much has been heard during the last few years of the slides that are taking place in the sides of the Culebra cut, on the Panama canal, and in some quarters they have been attributed to tectonic movements. It is desirable therefore to quote the opinion given by Vaughan Cornish, an independent geologist, connected neither with the management nor with certain hostile camps. Mr. Cornish has recently returned from one of his periodical visits to the isthmus, and gave his impressions in a lecture before the West India Committee. A report of this lecture is given in the *West India Committee Circular* for March 24.

Mr. Cornish mentions that the rocks through which the cut is driven are igneous, but belong to two entirely separate groups. The main country is an ancient solid igneous rock which forms the peaks and does not disintegrate, while the saddles and lower parts consist of a volcanic sedimentary which is rotten and easily slides. The old igneous rock stands well, and no trouble is experienced with the steep sides where the cut passes through this rock. On the other hand, the recent rocks on the saddles or abutting on the peaks are the cause of the trouble, even where the angle of slope is gentle. In this connection we observe that the American Institute of Mining Engineers during the visit in 1910 did not apparently differentiate between the two types of rock, as the report simply says that the cut is through an igneous rock that rapidly disintegrates. In making the cut, the two ends attained their greatest depth before the middle part, as the excavation was planned so as to use gravity as far as possible in removing the earth and broken rock. The landslides naturally began at the ends, and as they occurred the debris was cleared away. At many of these disturbed points, the surface is now covered with grass or other vegetation, and no further movements appear probable. The slides that have occurred at the central portions, which were the last to be excavated, have attracted more attention, as they occur after the completion of the work and postpone the opening of the waterway. The first symptom of a slide is the cracking of the ground, to be followed by a general break and an uplifting of the bottom. The rock at the bottom may rise 10 ft. in as many minutes. After the material has risen in this way, the sides of the cut slide downward to the centre. Every engineer, of whatever country, who had given advice had considered an angle the tangent of which is 1·5 suitable for the sides of the Culebra cut. This estimate has proved utterly wrong, for slopes of 1 in 5 are still sliding. It is only by carefully studying the slides that have been experienced from the beginning of the cut that any estimate of the ultimate issue can be estimated. At the time of Mr. Cornish's visit, dredging and sluicing were being energetically conducted, and it was hoped to clear the water-way by August next. There are, however, a number of other suspicious places, where serious slides may possibly occur. Mr. Cornish therefore keeps an open mind as to the likelihood of the canal being continuously navigable from January 1915, the date fixed for the official opening. In reply to a number of questions, Mr. Cornish said that the volcanic rock was not being rotted by the admission of the water, and that at some places the bottom still showed signs of bulging upward. He thought that eventually it would be necessary to sluice the ground from the crest of the saddle ridges into the valleys in the opposite direction to the canal, and so flatten the ground as to make further slides impossible. It would then be desirable to cover the banks with vegetation. The possibility of earthquakes wrecking the canal was also discussed. It is true that earthquakes occur in Panama occasionally, but they are not of so acute a nature as to cause trouble in the locks and cuts of the canal.

Gold Dredging in the Philippines.—The 'Mineral Resources of the Philippine Islands,' published by the United States government at Manila, contains a review of the progress of gold mining, placer and lode, in those islands. In the Paracale district (see the map given on the opposite page), four dredges are at work, each belonging to a separate company. Two are of the New Zealand type and two were built in the United States. It is impossible to make comparisons between their work and efficiency, as the nature of the ground varies widely. The largest is called the 'Governor Gilbert,' and is at work on the Gumaus river, being owned by the Gumaus Placer company. It was designed by the New York Engineering company, and was put into commission on September 25, 1912. The alluvium varies in character and depth. The top layer is sandy clay over 9 ft. thick, under which are layers of clay, sand, and gravel, with a bottom layer of light coarse sand 7 ft. thick. The bedrock is a decomposed granitic gneiss. The ground is rich and substantial dividends have been paid already. The capacity is 5000 cubic yards per 24 hours, but it is not advantageous to treat more than 2900 cu. yd. The hull is 120 ft. long by 46 ft. wide, including a 3-ft. overhang on each side. Selected Oregon pine is used, and the construction was made extra heavy. The keelsons have a cross section of 12 by 16 in; the deck, floor beams, and stanchions, 6 by 10 in.; the floor beams are spaced 2½ ft. apart. Two tie beams at the after end of the well are 12 by 10 in. in section, while a third is 14 by 10 in. The diagonal stays are 4 by 8 in. in section, and the centre frames are 6 by 10 in. The bottom, sides, and deck are made of 4-in. planking, while the well-holes stern and bow use 6-in board. Tarred felt lies upon the planking, and this is covered outside with a sheathing of 1·5-inch native hard wood. This affords protection from teredos. The bow gantry, of American type, measures 26 ft. from deck to top cap. The main and diagonal posts are 12 by 16 in. in section, and the joints are reinforced by ¾ in. steel plates. The cap, weighing 3½ tons, is built of structural steel fitted over the gantry frame. The stern gantry measures 60 ft. from the deck, and is built of 12 by 12 in. main posts with 8 by 12 in. diagonal stays. Upper truss chords, running between gantries, are 12 by 16 in. For even distribution of stress and strain, the centre of the dredge is held to the upper truss chord by 2-in. square steel rods fitted with turn-buckles. The digging ladder is built of structural steel, and has a length of 87 ft. between centres. A return drip pan is used. The end of the ladder is cast steel. The ladder hanging shaft has a diameter of 12 in., and rests in a large steel frame containing the driving-gear shafts. This enforces alignment of the driving mechanism. The rollers, 16 in number, have a diameter of 16 in., and weigh 1500 lb. each. The bearings are grit-proof and adjustable. The ladder has a weight of 28 tons exclusive of buckets, rollers, and tumblers.

The lower tumbler, which weighs 4 tons, has wearing sides lined with manganese steel. A $1\frac{1}{2}$ in. tie bolt runs through the centre of the tumbler-shaft in order to prevent the ladder from spreading. The shaft runs in water-tight grease bearings. The upper tumbler, which weighs 7 tons, has manganese-steel wearing plates; the shafting is 16 in. in diameter, and is driven by double, machine-cut gearings. The buckets, 84 in number are close-connected, have a capacity of $5\frac{1}{2}$ cu. ft., and operate at a speed varying up to 22 per minute. The body of the bucket is of cast steel; the lip is made of $1\frac{1}{2}$ in. manganese steel; each bucket weighs 1300 lb. Manganese-steel wearing plates take up the wear of the tumblers. The link pins are $4\frac{1}{2}$ in. in diameter. The screen is 32 ft. long and has an inside diameter of 5 ft. It is built of $\frac{1}{2}$-in. steel perforated plates bolted to the frame, and can easily be removed when worn. The perforations vary from $\frac{1}{4}$ in. at the upper end to $\frac{5}{8}$ in. at the lower end. Flat manganese steel bars are bolted inside to help to break up the clay. The screen is driven by friction rollers at each end.

The tables are double-banked, and a total area of about 3000 sq. ft. is obtained. The tables are of the riffle type, and are set at a slope of $1\frac{1}{2}$ in. to the foot. The riffles are made of wood covered by $1\frac{1}{4}$ in. strap iron; the spacing is about 1 in. The transverse chutes have a width of about 29 in., and the longitudinal chutes have a width of about 32 in. In passing from the transverse chutes to the longitudinal chutes, the sand makes a drop of about 6 in. to a $\frac{1}{4}$ in. steel plate. Three of the longitudinal chutes, on each side of each bank, are outboard, and lead to a steel stern chute with a 20-ft. overhang. Mercury is used in the riffles close to the screen. The dredge is driven by steam supplied by a water-tube boiler. Hillside wood is used, about 13 cords of wood being used per twenty-four hours.

The conveyor ladder is made of structural steel, of the lattice-work type. A 3-ft. Jeffrey conveyor belt is used. Owing to the shortness of life of rubber belting in the tropics, the stacker maintenance-cost may prove to be high. The dredge is kept to the face by a digging spud consisting of a steel girder, 2 by 3 by 55 ft., weighing $10\frac{1}{2}$ tons. The stepping spud, of wood, 2 by 3 by 50 ft., weighs 5 tons. In addition $\frac{3}{4}$-in. flexible steel bow and stern side lines are used.

Nomenclature of Alloys.—The Institute of Metals is engaged in standardizing the nomenclature of alloys. The vast variety of binary, ternary, and complex alloys makes it desirable to have a scientific classification, with a system of names indicating the nature of the constitution of the individual alloy. It is also desirable to standardize the 'practical' names, that is, the names likely to be acceptable in the metal trade and in the factory, and to invent short or condensed words suitable for use in this way. A committee was therefore formed in collaboration with the institutions of mechanical and electrical engineers, the naval architects, shipbuilders and engineers, etc. After much discussion it was decided that the only satisfactory basis of classification is the chemical composition by weight. The metals constituting the alloy are to be ranged in order of their proportion by weight, that with the smallest amount coming first. Thus an alloy of 8% aluminium and 92% copper would be called an 'aluminium-copper,' while one containing 3% copper and 97% aluminium would be a 'copper-aluminium.' One composed of 1% tin, 29% zinc, and 92% copper would be a tin-zinc-copper. If an alloy consists of more than three metals, it is suggested that the word 'complex' should denote the aggregate of those other than the three present in the largest proportion; though if one of the smaller constituents had a special effect on the nature of the alloy its name should be used instead of

the third by weight. For instance an alloy might contain 75% aluminium, 15% tin, 4% arsenic, 3% cobalt, 2¾% iron, and ¼% indium; if the latter was of special importance, the name of the alloy would be 'indium complex tin-aluminium.' It is obvious that this system, though highly acceptable to scientific investigators, would be too cumbrous for the trade and the workshop, so efforts are to be made to establish short words for the binary alloys. So far the committee has only come to a decision with regard to the regularization of the words 'brass' and 'bronze.' 'Brass' is to be used as an abbreviation of zinc-copper, and 'bronze' of tin-copper. An alloy containing 1% tin, 29% zinc, and 70% copper would be called 'tin-brass.' When this subject was first discussed by the Institute of Metals two years ago, attention was drawn to the misleading names of such alloys as 'manganese bronze,' which consists of a brass with a small percentage of manganese, and 'aluminium bronze,' which is an alloy of copper with a small admixture of aluminium. The coinage of suitable short words to represent the various other groups will afford an opportunity for scientific linguists.

CURRENT LITERATURE.

Preserving Mine Timbers.—*The Colliery Guardian* for March 20 contains an account of 'aczol,' a preparation made by a firm in Brussels for preserving mine timbers. It consists of a mixture of mineral salts and phenol, the former acting as a mordant for the latter.

Hygiene in Coal Mines.—Dr. Frank Shufflebotham delivered a course of lectures in March before the Royal College of Physicians on hygiene in coal mines. They have been reported in an abridged form in *The Colliery Guardian* and the *Iron & Coal Trades Review*.

Dust Prevention.—The January *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa contains a paper by B. C. Gullachsen on the prevention of dust in underground workings.

Mining at Nome, Alaska.—In the *Mining and Scientific Press* for March 7, Arthur Gibson describes the results of drift-mining in the frozen gold-gravel deposits at Nome, Alaska.

Leaching at Oroya Black Range.—The *Monthly Journal* of the Chamber of Mines of Western Australia for January contains a paper by W. B. Chomley describing the sand-treatment plant at the Oroya Black Range mine.

Cornish Tin Lodes.—At the March meeting of the Cornish Institute of Engineers, T. C. F. Hall read a paper on the geological history of Cornish tin lodes.

Genesis of Mercury Deposits.—The February issue of the *Bulletin* of the American Institute of Mining Engineers contains a paper by J. Allen Veatch describing the mercury deposits of the Pacific slope and discussing their genesis.

Nickel in the Urals.—The *Bulletin* for February of the American Institute of Mining Engineers contains a paper by H. W. Turner on the occurrence of nickel ore in the neighbourhood of Ekaterinburg, in the Ural Mountains.

Alaska Coal.—In the *Mining and Scientific Press* for February 21, W. R. Crane describes the coal deposits on Bering river, Alaska, and the methods of developing them.

Sun-Power.—*The Engineer* for March 20 gives further details of the sun-power steam-raising plant in Egypt erected by Frank Shuman, of Philadelphia.

Montana Mining Co.'s Litigation.—The *Mining and Scientific Press* for February 28 prints Charles W. Goodale's paper read before the Butte section of the American Institute of Mining Engineers on the apex law in the Drumlummon controversy, recounting the old litigation between the St. Louis Mining and Milling Co. and the Montana Mining company.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be obtained on application to The Mining Magazine.

NEW BOOKS

Mine Sampling and Valuing. By C. S. Herzig, with a chapter on Sampling Placer Deposits by Chester Wells Purington. Cloth, octavo, 160 pages. London: *The Mining Magazine*; San Francisco: *Mining and Scientific Press*. Price 8s. 6d. net.

The author claims that the need of a work of this description is demonstrated by the fragmentary character of most of the literature of the subject, and also because the principles and methods of mine-sampling as taught in schools of mines, and in the standard textbooks, do not deal with it in sufficient detail. In the schools, the students are taught to sample parcels of various classes of broken ore under ideal conditions, with conventional appliances, such teaching being an inadequate preparation for the field-work of the general practitioner, who has to obtain correct and reliable samples from massive orebodies in place, often with elementary appliances and under conditions that, as the author points out, require an unusual combination of qualities to make a successful and satisfactory mine-valuer.

In an unusually neat and unpretentious dedication —"He Blazed the Trail,"—the author has paid a delicate and well deserved compliment to Mr. T. A. Rickard, who wrote an earlier textbook, 'The Sampling and Estimation of Ore in a Mine.' He also acknowledges our indebtedness to Mr. H. C. Hoover for the invaluable contribution on mine valuation appearing in his book, the 'Principles of Mining.' He also specially thanks Messrs. Frank H. Probert, Lloyd T. Buell, and E. N. Skinner for information regarding churn-drilling, and Mr. H. S. Munroe for his elaboration of a new 'gravimetric' method of calculating average values.

Written primarily to serve as a guide to the young engineer, there can be no doubt that this work deserves the close attention of our older and more experienced practitioners. It contains several heretofore unrecorded methods of sampling mines, and of their application in obtaining accurate valuations. These are put forward, at times, with marked originality, and where necessary new terms are coined or borrowed, sometimes from the terse and pithy vocabulary of the West. These, though open to criticism from the literary standpoint, are expressive, and in some cases fill a long-felt want.

In the comparatively short space of 160 pages the author has compressed a large amount of valuable information, making this book a noteworthy digest of the art of mine sampling and valuing. It is published in such a condensed form as to render it a textbook and vade-mecum of the profession, to be found alongside the indispensable engineer's pocketbook in his travelling kit.

It must be strictly borne in mind that the work deals specially with the requirements of the "independent engineer," as distinguished from the problems of the permanent staff of a mine in full work, in which the procedure is more normal. The expression "independent engineer" often used in the text to denote an engineer not connected with the permanent staff and therefore "independent" in that sense, is liable to be misinterpreted without some such explanation as I have given. The author, who is a notable exponent in this particular branch of the service, has shown great ability in overcoming difficulties, and his methods and suggestions, drawn from a ripe and varied experience, are admirable. There is no pretence of dealing with the wide range of subjects on conventional lines. The author does not adopt an academic style, but in a short, crisp, practical way, peculiarly his own, analyses every detail of the subject, from channel-moiling, churn drilling, and the special methods involved in sampling placer deposits, down to such minutiæ as the handling of samples, and methods of numbering and even tying and sealing sample sacks. His views are given with decision and clearness. There is no half-way house on the author's route, and even on points where there is room for difference of opinion, his conclusions are stated with uncompromising certainty. It only remains to say that outside of a few debatable points, which do not materially affect the results, the methods are correct, and the advice reliable and sound.

In the second part of the book, the interpretation of the results obtained by the operations described in the first part are elaborated with equal facility. A new method of calculating average values—the gravimetric method—is favourably criticized, with the reservation that while the arguments in favour are extremely strong, judgment should be suspended until greater experience has sufficiently tested the method to show its practical limitations. He shows, however, that the specific gravity factor may affect the accuracy of calculations of average values to a greater extent than is generally appreciated.

A chapter is devoted to the important subject of amortization of capital, which is still one of the weak points in the accounts of many companies, due mainly to the fact that the mining engineer and the chartered accountant have not yet come to a definite agreement on some issues. The matter is treated in a thoughtful way and will be read with interest by accountants, directors, and secretaries of public companies.

The chapter on the 'Sampling of Placer Deposits' by Mr. Purington is excellent, and it is interesting to note that it contains new matter throughout, and does not in any way overlap the text preceding.

Finally, it must be admitted that this textbook has been properly classified as a practical description of practical methods employed by a practised engineer in sampling and valuing mines containing ore deposits of widely different character in almost every part of the world, and it will surely find a place in the library of every student, and of every serious practitioner.

W. H. TREWARTHA-JAMES.

Mines Accounting and Management.—By Lawrence R. Dicksee. Cloth, octavo, 100 pages. London: Gee & Co. Price 5s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This book is one of Gee & Co's. admirable series of accountancy publications. The author is a well known writer on all classes of accountant's work, and he has published already at least a dozen books dealing with individual branches of an accountant's practice, one of which, 'Auditing' has reached its ninth edition. Thus he is well qualified to deal with the phase of mining accounts, though the subject of mine management is of too wide a scope to be treated within the limits of the book. The primary object of the book is to provide mining students attending the course at the Imperial College of Science and Technology with a short handbook that will explain to them the manner in which the various transactions involved in carrying on a mining undertaking should be recorded in the accounts kept at the mine, and how the information thus collected is transmitted to the headquarters of the owners of the mine. For this purpose it has not been considered necessary to formulate any elaborate and complete system of double-entry account keeping, such as is employed in mines operating on a large scale, and its scope is explained as giving guidance more particularly for the young mine manager operating comparatively small concerns, the accounts of which have not already been formulated by an expert. Within the limitations thus set, he has well covered the ground, down to a hint as to how to detect manipulations of figures by the directors at home. The definition of capital expenditure and of revenue expenditure is short and clear, but of an elementary character, and does not solve all the complicated questions arising.

W. H. TREWARTHA-JAMES.

The Copper Handbook. Founded by Horace J. Stevens. Edited and published by Walter Harvey Weed, Houghton, Michigan. Octavo, 1450 pages Price 21s. net in cloth, 31s. 6d. net half leather. For sale at the Technical Bookshop of *The Mining Magazine*.

The founder of the 'Copper Handbook, Horace Jared Stevens, was a great man. His book was no mere dry compilation of official records; it included also trenchant criticisms of mines and methods. Many were the threats, physical and legal, received at the editorial sanctum, but none of them materialized. Mr. Stevens carried on the work single-handed, and, on more than one occasion, under distressful conditions, owing to the break-down of his health; but he was always cheerful, active, and kindly candid. His death at a comparatively early age was universally regretted, and at one time there was a fear that his life's work would cease with his own demise. Fortunately, Walter Harvey Weed decided to purchase the copyright and business and to undertake the onerous editorial work. Mr. Weed is well qualified for his self-imposed task. He is one of America's foremost economic geologists, and during his connection with the United States Geological Survey made many detailed examinations of copper districts. We need only mention his Butte monograph to illustrate his high accomplishments. Moreover, he has given us an English translation of Richard Beck's book on ore deposits, and he has written a book on the copper deposits of the world.

Mr. Weed divides the copper mines into two sections, the first dealing with those in North America, and the second with those throughout the rest of the world. In case a mine outside the United States is controlled by American financiers and managed by American engineers, reference is made in both sections. The particulars given include geological descriptions of the deposits and the machinery and plant used at the mine and smelter, in addition to the facts relating to the organization of the companies. The dead or merged companies are not included in these lists, but are relegated to an appendix by themselves, with as much information as available. There is also an index of countries, states, and districts, by means of which the distribution of copper deposits throughout the world can be studied, or the memory refreshed in case the exact name of a company is forgotten. Another appendix is devoted to statistics of production, dividends, prices of the metal, etc. Mr. Weed does not give us a résumé of metallurgical practice, a feature of Mr. Stevens' volumes that was particularly acceptable on this side, though it is true that occasionally Mr. Stevens, through stress of circumstances, allowed this metallurgical portion of the volume to lag behind. With regard to the reliability of the information given about the individual mines and companies, we find that Mr. Weed's personal knowledge of American and European mines has stood him in good stead. On the other hand, we feel that some of the English and Australian companies have not been as communicative or as generous as they should have been. A casual reviewer might delight in mentioning a number of trivial inaccuracies. With our great confidence in Mr. Weed, we prefer to lay the blame on the officials of the various companies, who as a rule have no knowledge of even the existence of an eminent geologist, and therefore are disinclined to take what they consider the unnecessary trouble to comply with his desires. We take this opportunity of entering a plea on Mr. Weed's behalf with company officials that they should in future do everything in their power to make the Copper Handbook absolutely accurate. E.W.

The Diamond Fields of Southern Africa. By Percy A. Wagner. Cloth, crown quarto, 360 pages, with many illustrations and maps. Johannesburg: *The Transvaal Leader*; London: *The Mining Magazine*. Price 27s. 6d. net cloth, 32s. 6d. net half leather.

For some years we have known Percy Wagner as a geologist who would sooner or later win for himself a place in the scroll of fame. As a student at the South African College at Cape Town, and at the South African School of Mines and Technology at Johannesburg, he showed his conspicuous ability, and afterward he won high honours at Freiberg. Electing to become by profession a mining geologist, he made a speciality of the diamond. For seven years he has made a close study of all the alluvial and kimberlite deposits and mines in Africa. His knowledge of geology and chemistry has afforded him the ability to benefit by his unrivalled opportunities for studying the diamond in its native haunt. His combined shrewdness and generosity have enabled him to pass penetrating but kindly criticism on the evidence and opinions made public by his confreres. His elders, such as R. B. Young and David Draper, point with pride to the success of this brilliant South African student. Mr. Wagner published a small book in 1909 on the 'Diamond in South Africa' in the German language. Since then his continued close touch with the subject has provided him with new material and new ideas, and the present volume is much more than an enlarged English edition of his first essay. The book is divided into two sections, the first dealing with the primary occurrences in kimberlite, and the second with the alluvial and detrital deposits. In the first section, chapters are devoted to the geology, mineralogy, and petrography of the kimberlite occurrences; a consideration of the xenoliths, that is, the other rocks and crystals enclosed in the kimberlite; descriptions of the various forms and types of diamond; a discussion of the genesis of the diamond; and accounts of the methods of mining the kimberlite and recovering the diamonds therefrom. In the second section, the author describes the alluvial deposits of the Vaal river basin and the Orange river valley, and detrital deposits in German Southwest Africa. There are also chapters giving particulars of the companies operating in Africa, the laws governing the industry, and discussions of the economic factors involved in the marketing of the product.

We have read Mr. Wagner's remarks on the origin of the diamond with particular interest. He does not take seriously the theory advanced by Orville Derby, which was the subject of an article by Mr. Draper in the issue of this magazine for September last. Mr. Derby holds that the "diamond is a secondary mineral crystallized out of some carbon-bearing solution that was capable of dissolving the rock (or some part of it) in which it occurs, and thus of opening a space for it." Mr. Wagner classes this theory among the "more fanciful hypotheses." The three principal theories discussed by him are as follows: (1) that the diamond was formed by the crystallization of carbon derived by the kimberlite magma from the carbonaceous Karroo beds pierced by the dikes and pipes; (2) that it has been derived from the explosive disruption of a deep-seated diamond-bearing eclogite, and that its presence in kimberlite is purely accidental; (3) that it is an original constituent of kimberlite. Objections are raised against the first and second theories, while ten separate facts are brought forward to confirm the third. The most direct evidence is provided by the experiments of Friedlander, Hasslinger, and Wolff, who have shown that carbon is soluble in molten olivine and in silicates similar to kimberlite. Wherever diamonds have been found in the original matrix, they are associated with the olivine group of minerals. As regards the source of the carbon, Mr. Wagner points to the established fact that all igneous rocks occlude carbonic acid and hydrocarbons.

Another part of the book that arrests the attention of the reader is the chapter describing the deposits in German Southwest Africa. The first discovery was made at Kolmanskop, where the diamonds are found in the sand dunes. A short time afterward, similar deposits were noted along the coast from Luderitz bay southward, and the deposits have been proved to extend beyond low water. In all probability they come from a primary formation in the locality.

If our space permitted we should like to make many more quotations. As it is, we must content ourselves to recommend all geologists and mining engineers to become personally acquainted with Mr. Wagner's masterpiece. E.W.

The Electric Furnace: Its Construction, Operation, and Uses. By Alfred Stansfield. Cloth, octavo, 420 pages, with many illustrations. New York: McGraw-Hill Book Co. Price 17s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

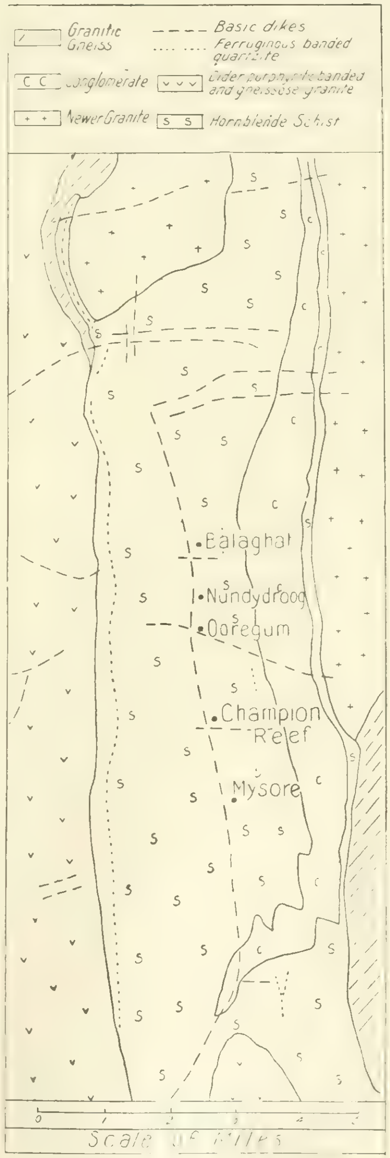
This is the second edition, revised and enlarged, of a book that has proved acceptable to metallurgists desirous of obtaining a concise statement of the possibilities of electric methods of smelting. The author is an Associate of the Royal School of Mines, and is professor of metallurgy in the McGill University, Montreal. The use of electric heat is rapidly extending in many directions. Special steels are made in electric furnaces, aluminium is smelted in them, carborundum and allied substances are produced in them, as also are carbides. Much work is being done in connection with zinc ores, and the application of the principle to copper smelting occupies the attention of experimenters. The electric current is used in many other ways, for the production of sodium, the electrolysis of salt, the fixation of atmospheric nitrogen, and the refining of metals. An outline of the theory and practice of all these processes is given. The author is thoroughly in touch with his subject, and the information he gives is perfectly dependable.

COMPANY REPORTS

Mysore Gold.—This company was formed in 1880 by John Taylor & Sons to acquire old workings in the Kolar district, Mysore state, Southern India. Dividends were first paid in 1886. The ore crushed from the commencement until the end of 1913 totalled 3,917,109 short tons, for a yield of gold worth £15,281,811, out of which £7,414,344 has been distributed as dividends. The increase of tonnage and yield has been practically continuous. The report for the year 1913 shows that 302,662 tons of ore was raised and milled, yielding 201,928 oz. bullion, and 264,829 tons of tailing cyanided yielding 30,240 oz. bullion, the total gold being valued at £905,090. The working cost was £366,898, royalty £57,037, income tax £27,938, allowance for depreciation £15,338, expenditure on shaft-sinking and new plant £65,063, allocation to reserve fund £25,000, directors' and managers' proportion of profits £4135, and dividends to shareholders £381,250. The working cost was slightly higher than for the previous year owing to several causes, among which may be mentioned the occurrence of a number of 'air-blasts,' the necessity for retimbering shafts, and the accident to the winding engine at Edgar's vertical shaft. During the year, 27,331 ft. of development work was done. In Ribblesdale's and McTaggart's sections the ore disclosed was of lower than average grade, but Tennant's section has continued to provide high-grade ore. The directors say that "the fact that the reefs are maintaining good widths and continue auriferous in depth affords every encouragement to look upon the falling off in productiveness as temporary only." The reserve at December 31 was estimated at 1,377,102 tons, an increase of 39,104 tons as compared with a year ago, but the average content is not given. A slime plant having a capacity of from 10,000 to 12,000 tons per month is being provided and should be ready for operation in August. The new vertical shaft in McTaggart's section is down 712 ft. Preparations are in hand for deepening Edgar's shaft from 2600 ft. to 4000 ft.; at the present time the new winding engine is being erected.

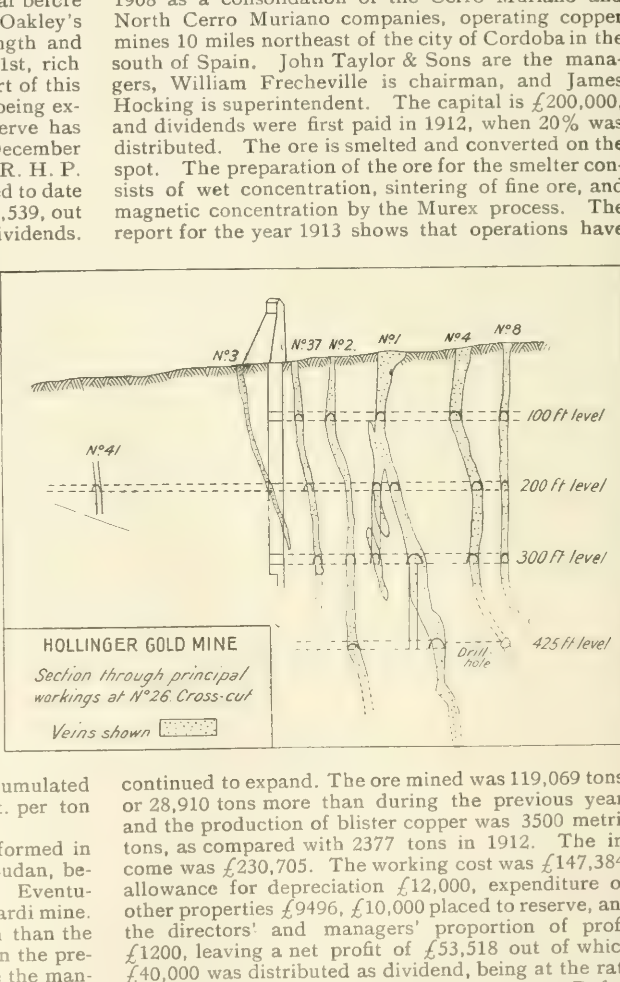
Nundydroog.—This company was formed by John Taylor & Sons in 1880 to acquire a part of the lode on which the Mysore mine is situated, in the Kolar district, Mysore state, India. Dividends have been paid continuously since 1888, and the total distribution has been £2,002,768 from gold worth £5,276,256 won from 1,526,554 tons of ore. Three periods of depression have been experienced. The first and second were in the years 1892 and 1898 respectively. The third started a year ago and still exists. At the beginning of 1913, the developments at depth were discouraging, so the monthly output of ore was reduced from 8000 to 7500 tons. In November last it was announced that some improvement had taken place, but the expectation that it would be maintained has not been verified. The report for the year 1913 says that the development work during the year "has been attended with a fair measure of success." The amount of ore raised was 90,650 short tons and the yield was worth £304,325, as compared with 100,552 tons and £330,937 the year before. The working cost was £144,098, the royalty £19,250, income tax £9461, directors' and managers' share of profits £2971, and expenditure on plant £30,052. The shareholders received £99,050, being at the rate of 35%. The ore reserve on December 31 was estimated at 150,650 tons of unspecified content. A circular shaft is to be sunk to intersect the lode at 4000 ft. on the dip or 3500 ft. vertically. It will be started at a point 1400 ft. west of Kennedy's shaft and will occupy a central position with regard to the chief productive shoots.

Ooregum Gold.—This company owns one of the gold mines of the group managed by John Taylor & Sons in the Kolar district, state of Mysore, India. Operations commenced in 1888. The quality of the ore has never been as high as at the Mysore mine, and on more than one occasion there has been cause for anxiety with regard to developments. Nevertheless dividends have always been paid. The report for the year 1913 shows that the depression of 1912 has given way to more cheerful results and prospects. The ore milled was 153,636 tons as compared with 145,558 tons, and the yield of gold £360,888 as compared with



GEOLOGY OF THE KOLAR MINES.

£347,944. The yield was in fact the highest yet recorded. The dividends were £129,250, as compared with £120,231, the rate being 42½% on the 240,000 preference shares of 10s. each, and 32½% on the 481,544 ordinary shares of the same denomination. Excellent results have been obtained during development, though only 14,813 ft. of work was done, as compared with 16,061 ft. In Taylor's section, ore of satisfactory grade has been exposed in the 44th, 46th and 47th levels on the shoot discovered the year before south of the dike. In the southern part of Oakley's section, the main shoot is maintaining its length and assay-value, and on the deepest level, the 51st, rich ore is now being found. In the northern part of this section, ore of high grade and good width is being exposed on the three bottom levels. The reserve has been more than maintained, the figures at December 31 being 186,947 tons of unspecified content. R. H. P. Bullen is superintendent. The total ore mined to date has been 2,402,346 tons and the yield £6,639,539, out of which £2,214,320 has been distributed as dividends.



HOLLINGER GOLD MINE

Section through principal workings at N°26 Cross-cut

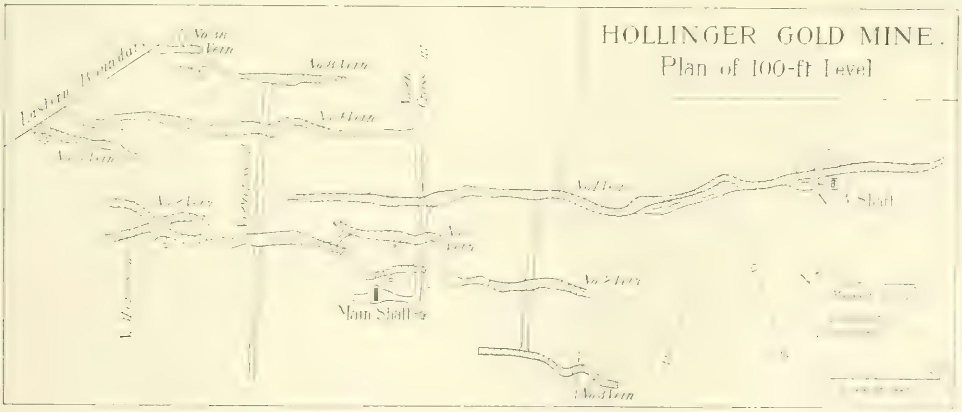
Veins shown

Barramia Mining & Exploration.—This company was formed in 1909 by John Taylor & Sons as a subsidiary of the Egypt & Sudan Mining Syndicate to acquire a gold mine in Egypt between Edfu near Assuan, on the Nile, and the Red Sea. The capital is £55,000 divided into 216,000 preference shares of 2s 6d. each, entitled to a non-cumulative dividend of 10% and half the further profits, and 112,000 ordinary shares of 5s. each. The mine was worked by the ancients, and the veins are narrow with occasional rich pockets. The report for the year 1913 shows that 4300 tons of ore was raised and treated in a 10-stamp mill, for a yield of gold worth £17,823. After allowance for depreciation and tax was made the net profit was £2641. Out of this, £2542 has been paid as 10% dividend on the preference shares. F. J. Tregay, the manager, reports that a large amount of development work has been done but with indifferent results. The reserve on December 31 was estimated at 16,500 tons. Investigations are now being made with a view to the treatment of accumulated sand and slime which average 5 and 4 dwt. per ton respectively.

Sudan Gold Field.—This company was formed in 1904 to acquire prospecting licences in the Sudan, between the 20th and 22nd parallels of latitude. Eventually operations were centred on the Om Nabardi mine. The mine is about 300 miles farther south than the Barramia, particulars of which are given in the preceding paragraph. John Taylor & Sons are the managers, and H. B. Williams is superintendent. The plant contains 10 stamps and a cyanide annexe, the latter being added in July 1912. The capital was originally £300,000, of which 145,000 shares of £1 each were issued as purchase price, and £155,000 subscribed in cash. In 1908 the company was reconstructed, the £1 shares being reduced to 10s., and issued with a liability of 4s. No dividend has yet been distributed. The report for the year 1913 shows that 17,049 tons of ore was milled, yielding by amalgamation and cyaniding gold worth £39,597. The working cost was £33,586, and after writing off £2154 for depreciation and £3000 from the development account, a profit of £914 was recorded. The stock of accumulated sand has been exhausted, so that the yield by cyanide will decrease. On the other hand, it is proposed to erect a slime-treatment plant, which should add to the income. During the year, the developments have not been particularly satisfactory at the deepest point, 600 ft., of the main lode, but in Garland's branch increased amounts of high-grade ore have been disclosed. The reserve on December 31 was estimated at 42,000 tons, an increase of 15,000 tons during the year.

Cordoba Copper.—This company was formed in 1908 as a consolidation of the Cerro Muriano and North Cerro Muriano companies, operating copper mines 10 miles northeast of the city of Cordoba in the south of Spain. John Taylor & Sons are the managers, William Frecheville is chairman, and James Hocking is superintendent. The capital is £200,000, and dividends were first paid in 1912, when 20% was distributed. The ore is smelted and converted on the spot. The preparation of the ore for the smelter consists of wet concentration, sintering of fine ore, and magnetic concentration by the Murex process. The report for the year 1913 shows that operations have continued to expand. The ore mined was 119,069 tons, or 28,910 tons more than during the previous year, and the production of blister copper was 3500 metric tons, as compared with 2377 tons in 1912. The income was £230,705. The working cost was £147,384, allowance for depreciation £12,000, expenditure on other properties £9496, £10,000 placed to reserve, and the directors' and managers' proportion of profit £1200, leaving a net profit of £53,518 out of which £40,000 was distributed as dividend, being at the rate of 20%, the same as last year. From the San Rafael and Eastern sections, which together contain the workings on the Cerro Muriano lode, 86,128 tons of ore was raised, of which 55,498 tons was sent to the concentrating plant, 8894 tons hand-picked and sent direct to the smelter, and 6762 tons of fine sent to be sintered, the remainder being rejected. Smaller amounts were obtained from five other workings and from the dumps. The Murex plant treated 15,655 tons of middling and dump material averaging 1·3% copper, and produced 1281 tons of concentrate averaging 10% copper, the average recovery being 63%. The smelter treated 31,389 tons of ore, concentrate, and sintered material, producing 6837 tons of matte averaging 49·7% copper, and the converters produced 3500 tons of copper bars. Development during the year has given excellent results in the San Rafael section, where the lode on the 1410-ft level is longer and of higher grade than in any of the levels above. On the other hand the quality of the ore disclosed in the eastern section and on other ore-shoots has not been up to the average, so that the total ore reserve at December shows a fall in average content as compared with the year before, the figures being 206,489 tons averaging 3% copper, as compared with 200,025 tons averaging 3·35%. Improvements have been made during the year in connection with the drainage of the mine. In order to prevent surface water passing downward to the workings, concrete and cement channels have been provided for carrying away the rainfall.

Hollinger Gold Mine.—This company was formed under Canadian laws in 1910 to acquire a gold-mining property at Porcupine, Ontario. N. A. Timmins is president and P. A. Robbins manager. Milling started in June 1912 with 30 stamps. The capital of the company is $3,000,000. The report for the year 1913 shows that 138,291 tons of ore was raised and sent to the mill, averaging $18·56 per ton. The yield of gold was worth $2,465,978, the percentage of recovery being 96. The total cost was $843,159, leaving a profit of $1,628,113, out of which $1,170,000 was distributed as dividend. The capacity of the mill has been raised from 300 to 500 tons per day by the addition of 20 stamps, and plans are in hand for the erection of 15 more. The development work during the year has disclosed slightly more than was mined, the reserve on December 31 being 845,300 tons, averaging $13·71 per ton. No. 1 vein is the richest, containing 284,200 tons averaging $19·56 per ton. A year ago the average content was estimated at $28·86 per ton, and the reason for the drop is that during the strike in the earlier part of the year ore of higher than average grade was extracted in order to make up for the smaller amount that could be raised and milled. The accompanying illustrations give a transverse vertical section, and a plan of the 100-ft. level. As regards the future, Mr. Robbins points out that as the deposits are in pre-Cambrian formation it is legitimate to expect them to continue downward until some unfavourable change occurs in the country rock. No indication of such a change has been afforded as yet by mining or drilling operations in the neighbourhood. Under these circumstances he estimates the additional probable ore down to the level of the deepest working at 475,800 tons. The ore at this mine consists of sericite schist and quartz, and contains a high percentage of pyrite. It is soft and easily crushed. Cyanide solution is used in the stamp-mill, and the pulp is sent to concentrators. The gold is recovered from the concentrate by pan-amalgamation. The tailing from the concentrators is agitated and filtered.



HOLLINGER GOLD MINE.
Plan of 100-ft Level

East Pool & Agar.—The mines belonging to this company are situated between Camborne and Redruth, Cornwall, and were worked since 1834 on the cost-book system until the beginning of 1913, when they were sold to a new company registered under limited liability law. The old company was a pioneer of modern milling and concentration practice, and efficient recoveries were made of the constituents of a complex ore containing tin, wolfram, arsenic, and copper. Of late years the grade of the ore has greatly decreased, and owing to the consequent lack of funds the development fell behind. Bewick, Moreing & Co. took an interest toward the end of 1912, and under the guidance of their group the new company was formed. The issued capital consists of 55,481 shares of £1 each credited as fully paid, including 38,400 issued to shareholders in the old company, and 38,400 shares on which 7s. 6d. has been called up. The report now issued covers the period from the date of incorporation to December 31 last. During this time 68,216 tons of ore was raised and milled for a yield of 528 tons of tin concentrate, 45 tons of wolfram concentrate, 238 tons of crude arsenic, and 20 tons of copper concentrate, worth £62,176, £5036, £1965, and £100 respectively, a total of £69,277. The yield of black tin per ton was 17·35 lb. and the recovery was 72%. The revenue per ton from all sources was 20s. 4d. Only half the development cost, £8015, has been included in the profit and loss account; including this £4007, the total cost for the year was £70,028, so that the year ends with a small adverse balance. A great deal of preliminary work has been done during the year with a view of putting the mine in a better condition. The East Pool shaft has been widened and a new winding engine erected. The development totalled 4187 ft., much of it consisting in clearing old drifts and cross-cuts. No large body of high-grade ore is reported as having been disclosed. As the new ground is opened it is blocked in such a way as to make estimates easier and stoping cheaper. Rock-drills have almost entirely superseded hand-drilling. The proportion of wolfram in the ore has increased lately, and a second magnetic separator has been installed so as to augment the production of wolfram and to make a cleaner tin concentrate. Eight Holman air-cushion stamps have been continuously at work, and the daily capacity of each has been increased from 25 tons to 40 tons by means of a new mortar-box invented by W. J. Loring. A great deal of trouble has been experienced with regard to the underground labour. The men have resented any interference with their time-honoured privilege of coming to work when they like and absenting themselves when they like. In this way about 15% of the working time has been lost, as only 145,980 shifts out of a possible 169,760 were worked. Bewick, Moreing & Co. are doing their best to impress on the men that a low-grade mine can only be worked successfully when the attendance is regular, but they have not made much headway as yet in this desirable reform.

Carn Brea & Tincroft.—We have referred several times recently to this company operating tin mines at Camborne, Cornwall, and have mentioned that owing to disappointing developments the operations are being conducted at a loss. The mines have been worked since 1832, and in early years were profitable producers. The grade of ore in those days may be gauged by the fact that the old tailing dumps now being worked by the Cornwall Tailings Co. have an average tin content of 20 lb. per ton. The properties were taken over by the present company under limited liability in 1900. Profits and losses have alternated, the profits being made during the two periods of high prices for tin. Three years ago the directors, who are all local people, engaged E. S. King as consulting engineer. He effected many economies and increased the efficiency of the old plant. He has not however been able to find any large amount of high or medium grade ore. Last autumn the advice of the firm of James Brothers was sought, and W. H. Trewartha-James made an examination. He recommended the suspension of operations at the Carn Brea section. This mine is now idle, and pumping is being continued by the lords at their own expense. The report now issued covers the half-year ended December 31, and shows that the North Tincroft section is developing well. It is anticipated that before long this section will be self-supporting, and that it will respond to the expenditure of additional capital. Negotiations are in hand for the formation of a new company to take over the Carn Brea and South Tincroft sections. During the half-year, 38,780 tons of ore was raised, as compared with 45,537 tons during the preceding half-year, and the yield of tin concentrate was 342 tons as compared with 391 tons. The yield per ton was 20 lb. as compared with 19 lb.; the price received per ton £99 as compared with £123; and the income £34,567 as compared with £48,009. The sales of wolfram and arsenic brought the total receipts to £37,570. The working cost was £50,470 and lords' royalty £1347, so that the loss for the half-year was £14,247. In addition to the expenditure charged to working account as specified above, £7938 was spent on new plant out of money provided by one of the lords, Viscount Clifden, the loan being covered by a debenture issue.

Gopeng Consolidated.—This company was formed in September 1912 as an amalgamation of the Gopeng Tin Mining Co., and the New Gopeng, two companies that have for some years been successfully treating tin gravel on the east side of the Kinta valley, Perak, Federated Malay States. The consolidation was effected in order to facilitate the financing of the scheme for providing additional water-supply conjointly with the Kinta Tin company. The office of the company is at Redruth; James Wickett and several Cornish smelters are on the board; Osborne & Chappel are the managers. The report for the period from registration to September 30 last shows that 454 tons of tin concentrate was won from the Gopeng property, and 52 tons of tin concentrate and 1·73 tons of wolfram concentrate from the Ulu Gopeng property, which is worked by the Gopeng company for the Berwicks Estate. The income from tin sold was £56,304, and the profit from working the Ulu Gopeng £1985. An income of £2777 was made by the sale of rubber. The balance of profit was £46,338, out of which £30,656 was paid as dividend, being at the rate of 10% for the year on the capital paid-up. Unfortunately it has been inconvenient for some of the shareholders to pay their calls on the new shares issued to provide capital for the new water-supply, and the necessary funds have been borrowed from the company's bankers. The progress of constructing the pipe-line has been slow, owing to difficulty of transport and the unhealthiness of the district. The pipe-line is to be 7¾ miles long with a diameter of 45 in., and it will take 6000 cu. ft. of water per minute from the Kampar river.

Pengkalen.—This company was formed in 1907 by James Wickett, of Redruth, to acquire a tin-gravel property at Lahat, in the state of Perak, Federated Malay States. Osborne & Chappel are the managers. Operations commenced in 1909, with monitors and barges, and the yearly output of black tin has been between 300 and 400 tons. Owing to the high price of fuel, shallowness of ground, and influx of water, the cost has been high and no dividend has been distributed until this year. A year ago 10,000 preference shares were issued, bringing the issued capital to £100,000. The report for the year ended September 30 shows that three dredges were at work, and that 312 tons of tin concentrate was recovered, realizing £39,460. The working cost at the mine was £35,237, and the total cost £36,532. The preference shares received their 10% dividend, amounting to £1000. During the year one of the dredges was moved and enlarged. The old power-plant broke down in January, 1913, and the dredges were idle until the new electrical plant was completed. During the year, a lease has been taken on 300 acres at Pinji, some distance away. This property can be sluiced by gravitation alone, so that no pumps or dredger are required.

Kramat Pulai.—This company was formed in 1907 to acquire a tin-gravel property at Pulai, in the Kinta district of Perak, Federated Malay States, a little to the north of the Tekka and the Gopeng. Nutter & Pearse are the local managers, and F. W. Payne & Co. are the consulting engineers. The first dividend was paid in July 1912. The report for the year 1913 shows that two elevators were at work all the time and a third for 8½ months. The total yield was 202 tons of tin concentrate, selling for £24,142, figures almost the same as for 1912 and 1911. An additional income of £2561 was derived from tributers. The profit was £11,742, out of which £10,000 was distributed as dividend. Boring has proved the existence of 4 million cubic yards of ground averaging 1·7 lb. cassiterite per yard.

North Broken Hill.—This company was formed in Melbourne in 1895 to acquire property at the northern end of Broken Hill, New South Wales. In December 1912 the capital was expanded from £200,000 to £600,000 by the exchange of 3 new £1 shares for each £1 old share. The control is with the Baillieu group, and George Weir is manager. The report now issued covers the half-year ended December 31 last. During this time, 154,315 tons of ore was raised, the largest proportion coming from the 1100-ft., 1250-ft., and 950-ft. levels. The concentrator treated 154,829 tons averaging 15·8% lead, 13% zinc, and 7·3 oz. silver per ton, for a yield of 26,850 tons of lead concentrate averaging 69·1% lead, 6·5% zinc, and 22·6 oz. silver per ton. There were also produced 72,586 tons of zinc tailing averaging 3·7% lead, 17·5% zinc, and 3·8 oz. silver, and 16,609 tons of slime averaging 12·7% lead, 16% zinc, and 9 oz. silver. The zinc tailing was sold to the Amalgamated Zinc (De Bavay's) company for treatment. Some of the slime was delivered to the Junction North company. The working profit was £151,950, out of which £1924 was written off for shaft-sinking, £10,000 placed to reserve, and £120,000 divided among shareholders, being at the rate of 20% for the half-year. The development in depth has given excellent results. The main shaft was sunk from the 1250-ft. level to 1400 ft., at which level the lode was intersected in a cross-cut at 360 ft. from the shaft. By means of diamond drilling, the lode has been shown to be about 115 ft. wide, averaging 16·5% lead, 15% zinc, and 10 oz. silver. Thus the lode is richer and wider than at any level above. The ore reserve to the 1250-ft. level is estimated at 2,000,000 tons, and the probable ore below this level to the 1400-ft. level at 1,300,000 tons. Negotiations are in hand between the North, South, and Proprietary companies for the formation of a separate company to acquire the smelting works at Port Pirie belonging to the Proprietary company, with the object of working them in the joint interest of the three companies.

Broken Hill South Silver.—The report of this company for the half-year ended December 31 shows that 170,080 tons of ore was raised, chiefly from the 970-ft. and 1070-ft. levels, averaging 14·7% lead, 14·5% zinc, and 7·3 oz. silver per ton. The content of all three metals was higher than during the previous half-year, when the figures were 14·4%, 13·7%, and 6·5 oz. At the dressing plant, 27,594 tons of lead concentrate was produced, averaging 68·1% lead, 6·6% zinc, and 24·4 oz. silver. There were also produced 107,279 tons of zinc tailing averaging 3·5% lead, 17·6% zinc, and 3·6 oz. silver, and 21,675 tons of slime averaging 9·6% lead, 14·8% zinc, and 7·5 oz. silver. The current zinc tailing, together with 15,356 tons of accumulated tailing, was delivered to the Amalgamated Zinc (De Bavay's), and 29,405 tons of old zinc tailing was delivered to the Zinc Corporation. The accounts show an income of £318,920 from the sale of concentrate and £35,865 from the sale of tailing. The profit was £169,800, out of which £140,000 was distributed as dividend, being at the rate of 14s. per share. The development during the half-year has given satisfactory results, and the reserve above the 1170-ft. level is estimated at 3,350,000 tons. The company has an accumulation of 350,000 tons of slime, averaging 11·2% lead, 14·2% zinc, and 5·9 oz. silver. A concentrating plant, based on Owen's selective flotation method, is being built under licence from the Minerals Separation. The first unit will have a capacity of 500 tons per week, and eventually the plant will be increased to 2000 tons per week, half to be devoted to current and half to accumulated slime.

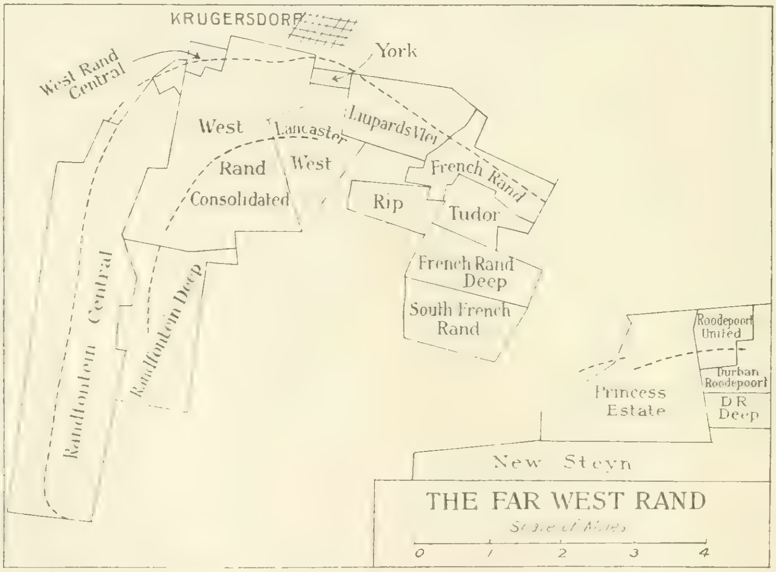
Rio Tinto.—Owing to labour troubles and to the lower average price of copper, the report of the premier copper and sulphur mine in Spain for 1913 is not so favourable as that for the previous year. The operations were interrupted by one or two minor strikes during the summer, and by a strike lasting for six weeks in October and November, when all the works were entirely closed. The amount of ore raised during the year was 652,168 tons suitable for shipment, and 1,207,403 tons suitable for local smelting and leaching, a total of 1,859,571 tons, as compared with 698,399, 1,708,570, and 2,406,969 tons respectively during 1912. The quantity of pyrites invoiced to consumers for both copper and sulphur content was 635,900 tons, as against 668,861 tons. The delivery of sulphur ore, both washed and crude, totalled 825,408 tons, as compared with 977,812 tons. The copper brought to market as metal was 21,062 tons, and in pyrites 15,258 tons, a total of 36,320 tons, as compared with 39,925 tons. The average copper content of all the ore mined was 2·19%, practically the same as in 1912. The accounts show a profit of £1,673,372, out of which £81,250 was distributed as 5% preference dividend, and £1,406,250 on the ordinary shares, being at the rate of 75%. For 1912 the ordinary shares received £1,678,500 or 90 per cent.

Namaqua Copper.—This company was formed in 1887 to acquire copper mines at Concordia, Little Namaqualand, South Africa, not far from Ookiep, the property of the Cape Copper Co. With the exception of two short periods, 1891 to 1894 and 1908 and 1909, the company has been prosperous and good profits have been made. In the latter period the low price of copper acted adversely, and it was then decided to adopt selective mining, treating only the better-quality ore and using one furnace instead of two. This altered policy has proved successful. The report for the year 1913 shows that the amounts of ore treated and the copper recovered were slightly lower than during the previous year owing to some less docile ore being included in the charge. The tonnage smelted was 35,302, of which about one quarter was in the form of briquettes. The matte produced amounted to 4266 tons, containing 2373 tons of copper. The cost of smelting was increased by the higher price of coke. An Elmore vacuum concentrator has been erected and is giving satisfaction in the treatment of low-grade ore and tailing. The concentrate is mixed with the fine ore and briquetted. The slime forms an excellent binding material. The old jig tailing and oxidized ores continue to be leached, and during the year 107 tons of precipitate containing 76 tons of metal was produced. The power plant recently erected, consisting of Diesel oil engines, is giving satisfaction. The development during the year has given good results and the reserve has been maintained. At the chief property, the Tweefontein, the reserve is estimated at 90,190 tons averaging over 6% copper, while the Julia is credited with 6900 tons and the Henderson with 9800 tons. The accounts show a net profit of £40,540. The shareholders received £42,449, being at the rate of 22½%. During the year the death occurred of Sir Frederick Mirrielees, who had been managing director from the first, and he has been succeeded by William Rich.

Dundee Coal.—This company was formed at Durban in 1899 to acquire a coal deposit in the north of Natal. Dividends have been paid from 1890 onward. In 1912 the mine was closed-down and the property of the St. George's Coal Co. in the same district was purchased for shares. Previously, in 1909, the Burnside mine had been acquired. The report for the year 1913 shows that 289,467 tons was raised from the Burnside and 159,888 tons from the St. George's. A third pit, the Lower Burnside, commenced output in December. The excellent quality of the steam coal has maintained the demand for as much as the mines can produce. The sales brought an income of £263,035, and the profit was £30,545, out of which £6230 was paid as debenture interest at 6%, and £12,225 as dividend on the ordinary shares. On the absorption of the St. George's company in April, the capital was increased by 62,500 shares of £1 each, and the issued capital now stands at £153,500. Operations were greatly impeded during the latter half of the year by labour troubles. The strike on the Rand caused a shortage of cars, and afterward the Indian labour difficulty arose. Since the end of the year, further strikes caused an idleness extending over three weeks.

Tweefontein Colliery.—This company belongs to the Henderson's Transvaal Estates group, and was formed in 1907 to acquire property in the Middelburg district of the Transvaal. The output commenced in the same year, and dividends were first paid in 1910. The capital issued consists of £45,847 in ordinary shares, and there are £90,000 debentures. The report for the year 1913 shows that 327,424 tons of coal was sold, an increase of 19,000 tons as compared with the previous year. The profit for the year was £20,256, out of which £5400 was paid as debenture interest, and £11,461 as dividend on the ordinary shares, being at the rate of 25%. Frank Simon, the manager, reports tbat the development is yielding excellent results, and that the mine could respond to an increased demand.

companies, the Brakpan and the Springs, particulars of which are given in the following paragraphs. The Transvaal Coal Trust worked the Brakpan colliery until 1908, when operations were suspended, and the De Rietfontein colliery until June 1913. Work is now confined to the Oogies colliery. The report for the year 1913 shows that during the five months operations at the De Rietfontein, 42,130 tons of coal was raised, bringing the total from the beginning to nearly 2 million tons. Some of the plant has been removed to Oogies, and the rest will be sold as opportunity offers. The output at Oogies was 405,269 tons, an increase of 80,000 over the previous year. A greater advance would have been made but for shortness of water-supply. Options on coal properties in the Breyten district have been allowed to lapse. The accounts show a profit of £19,673 from the sale of coal, and an income of £82,387 from Brakpan dividends. The shareholders received £95,508 as dividend, being at the rate of 17½ per cent.



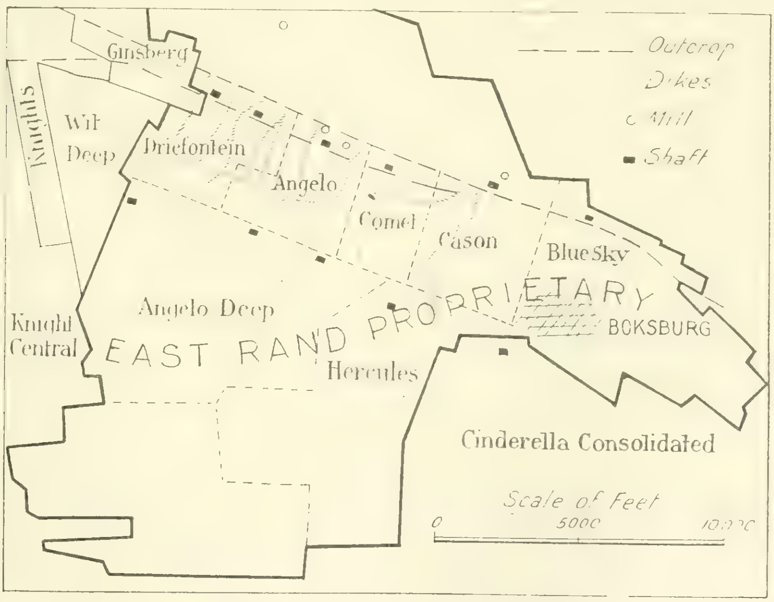
West Rand Central.—This company was formed as the White Rose Gold Mining Co. in 1895 to acquire a small property in the far west Rand north of the Randfontein, in a position indicated in the accompanying map. Additional capital was raised in 1897 by reconstruction, and the name was changed. Milling started with 20 stamps in 1898 and a slime plant was erected in 1907. The capital is £100,000; small dividends were paid in 1904 and 1905. The mine is one of the independent properties not affiliated to any of the big houses. Grantham Goodwin has been manager since the beginning. The report for the year ended September 30 last shows that 23,280 tons of ore was milled for a yield of 9358 oz., worth £39,665, or 34s. 1d. per ton. The working cost was £37,482, or 32s. 2d. per ton. During the year before 28,330 tons gave 10,309 oz. worth £44,678.

Transvaal Coal Trust.—This company was formed in 1889 to acquire the Weltevreden farm, afterward known as Brakpan, in the far east Rand, and several purchases of properties have been made subsequently, notably the adjoining De Rietfontein and the Oogies colliery in the Middelburg district. The gold deposits below the coal measures were transferred to subsidiary

Brakpan.—This company was formed in 1903 to acquire from the Transvaal Coal Trust a deep-level gold-mining property in the far east Rand. A large interest is held by the Consolidated Mines Selection Co. The property has been developed by two vertical shafts that cut the banket at 3122 ft. and 3829 ft. respectively, with an incline between them following the deposit. Milling was commenced in June 1911. During 1913 the results have not been so satisfactory as in previous years, owing to subsidences in the stopes during the early part of the year, to the labour troubles in July and after, and to the poor results of development. During the year, 695,173 tons of ore was raised and after the removal of waste, 613,269 tons was sent to the mill, where an average of 150 stamps and 8½ tube-mills were at work. The assay-value of the feed was 6·83 dwt. per ton. The yield of gold by amalgamation was 124,433 oz. and by cyanide 81,134 oz., a total of 205,567 oz., worth £865,315 being 6·7 dwt. or 28s. 2d. per ton. The total cost was £574,524 or 18s. 9d. per ton, leaving a profit of £290,790 or 9s. 5d. per ton. Out of the profit, £24,844 was allocated to extra expenditure, and £26,769 was paid as taxes. The shareholders received £243,750, being at the rate of 32½%. As compared with a year ago, the tonnage milled was 24,254 tons less, the gold recovered £130,308 less, the yield per ton 3s. less, the working cost 1s. 5d. higher, and the dividend £56,250 less. During the year, 19,650 ft. of development was done, of which 6951 ft. was on the deposit. Of the latter only 44% was in profitable ore, as compared with 63% the year before. The reserve was estimated on December 31 at 2,242,000 tons averaging 6·7 dwt. per ton, a fall of 215,000 tons on the year. Practically the whole of the rock-drilling is done with machines. The development of this mine was done by W. L. Honnold, who was consulting engineer until a year ago, when he was elected chairman, being succeeded as engineer by C. E. Knecht.

Springs Mines.—This company was formed in 1909 to acquire from the Transvaal Coal Trust an extensive gold-mining area in the far east Rand to the southeast of the Brakpan. The management is the same as that of the Brakpan. Two 7-compartment shafts have been sunk 4500-ft. apart, and in March and August respectively of last year intersected the banket at 3557 ft. and 3846 ft. respectively. The report for the year 1913 shows that 2700 ft. of development work has been sampled averaging 8½ dwt. over 33 inches. An extensive pumping installation was erected to deal with the water, and during the year 434 million gallons was sold to the Rand Water Board. The capital of the company is £795,000 in £1 shares, of which 330,000 were sold at 30s., providing funds to the extent of £495,000. On the exhaustion of these funds last year, an issue of debentures was made providing £315,000 additional capital.

East Rand Proprietary Mines.—This company was originally formed in 1893 to develop the Farrar interests in the east Rand. Individual properties were floated separately, but in 1908 were re-purchased and the operations consolidated. The producing properties are the Driefontein, Angelo, Comet, and Cason, and the Hercules section is now being developed. In 1911 it was found that the yield and profits were not coming up to expectations and changes were made in the staff. H. Ross Skinner became consulting engineer and W. T. Anderson manager. Members of the Central Mining group joined the board. A few months ago Mr. Skinner completed his reorganization of methods and resigned, Mr. Anderson being then appointed superintending engineer and E. C. J. Meyer manager. The report for the year 1913 shows that operations were disturbed by the strike in July, but not to the extent at one time expected. During the year 1,935,991 tons of ore was raised and, after the rejection of 9½% waste, 1,769,000 tons was sent to the mills. The 820 stamps ran 269 days and 25 tube-mills 301 days. The average content of the ore milled was 7·6 dwt. gold per ton. The yield by amalgamation



THE EAST RAND PROPRIETARY.

was 373,342 oz. and by cyanide 272,843 oz., a total of 646,185 oz. worth £2,718,483, the extraction being 7·3 dwt. or 30s. 9d. per ton milled. The percentage of recovery was 96%. As compared with the previous year the tonnage milled was 79,050 tons less and the yield 1s. 4d. per ton less. The working cost was £1,753,207, or 19s. 10d. per ton, or 1s. less than the previous year. The working profit was £965,276, and in addition a profit of £47,867 was earned by the treatment of accumulated slime. Out of the profit, £173,608 was spent on new plant and on shaft-sinking, £68,750 paid as debenture interest, £33,285 as contribution to the phthisis compensation fund, £44,895 as profits tax, £96,700 allocated to the extinction of debentures, and £611,474 distributed among shareholders, being at the rate of 25%. Development totalling about 10 miles was done during the year, but it was not sufficient to maintain the ore reserve, and Mr. Anderson is taking steps to increase the scale of operations. The tonnage developed was 1,530,226 of which 904,046 tons was estimated to average 6·9 dwt. per ton and the remainder unprofitable. The total ore reserve was 5,600,000 tons averaging 6·7 dwt., of which about

4,000,000 tons was in the Main Reef Leader, and the rest in the Main Reef or Main Reef and Leader combined. Special arrangements are being made for development below the 'water dike' coming from the Witwatersrand Deep. Large volumes of water will in all probability be encountered when passing through the dike and additional pumps are being provided. Much of the development work is at present centred on the Hercules deep section of the property. As regards the labour question, efforts have been made to introduce the small type of machine drill, but with indifferent results. The steep dip, narrow stoping width, and the nature of the hanging-wall combine to make it desirable to employ hand-drilling as far as possible.

Geduld Proprietary Mines.—This company belongs to the Goerz group, and was formed in 1899 to acquire property in the far east Rand, to the east and south of the Modderfonteins. Development work has been centred round No. 2 and No. 3 shafts, which intersected the deposit in 1905 and 1906 at depths of 1694 ft. and 1839 ft. respectively. Milling commenced in 1908, but was suspended two months afterward, owing to a sudden inrush of water, not to be resumed until February 1910. In July last, additional stamps and tube-mills were started, bringing the total to 60 stamps and 5 tube-mills. The necessary funds for the new plant and for the extra development required to increase the output to 24,000 tons of milling ore per month were raised by the issue of 125,000 shares at par in the year 1912. The report for the year 1913 now issued shows that 214,676 tons of ore was raised, and after the rejection of waste below and above ground, 182,980 tons was sent to the stamps. The assay-value of the feed was 7·6 dwt. The yield by amalgamation was 27,952 oz., and by cyanide 32,787 oz., a total of 60,739 oz., worth £257,268, being an extraction of 6·6 dwt. or 28s. 1d. per ton milled. The cost was £226,533, or 24s. 9d. per ton milled, leaving a profit of £30,735, or 3s. 4d. per ton milled. A balance of profit of £76,134 was brought forward from the previous year, making the unappropriated balance £113,437, out of which £47,177 has been spent on plant and development. No dividend has been paid. The issued capital is £875,000. Owing to the strike in July, the change in the method of treatment involved by the bringing of the additional plant into operation was greatly delayed and unavoidable expense incurred; and since then the labour supply has been insufficient for proper development work. The consequence is that though the yield per ton was increased by 1s. 5d., the cost was increased by 3s. 11d., from 20s. 10d. to 24s. 9d. per ton, with the result that the working profit was only £37,555, as compared with £56,996 the year before. The ore reserve on December 31 was estimated at 1,757,000 tons averaging 6·9 dwt., as compared with 1,492,257 averaging 6·83 dwt. the year before.

Van Ryn Deep.—This company belongs to the Barnato group, and owns a deep-level property in the far east Rand, on the dip below the Van Ryn, Kleinfontein, and Benoni. The report for the year 1913 now issued shows that milling commenced in July, and that an average of 70 stamps and 7 tube-mills ran from then onward to the end of the year. The ore mined totalled 246,218 tons, of which 25,562 tons was rejected underground. The ore hoisted was 173,043 tons, which, together with 40,756 tons from the dumps, was sent to the sorting station, where 30,799 tons of waste was removed, the remainder, 183,000 tons, averaging 8·1 dwt. per ton, being sent to the stamps. The extraction by amalgamation was 46,799 oz. and by cyanide 20,373 oz., making a total of 67,172 oz., worth £285,281, being a recovery of 7·4 dwt. or 31s. 4d. per ton milled. The working cost was £181,150, or 19s. 11d. per ton, leaving a working profit of £104,130, or 11s. 3d. per ton. Out of the profit, £1249 was paid as contribution to the miners' phthisis fund and £7126 as profits tax. The shareholders received £89,766, being at the rate of 7½%. Development has been giving gratifying results, and large additions have been made to the ore reserve. At the East shaft, the 5th and 6th levels have been extended east and west in excellent ore, and two winzes downward from the 6th level are in ore of good grade. The reserve on December 31 was estimated at 1,953,845 tons, averaging 8·6 dwt. per ton, based on a stoping width of 55 in. Allowing for 15% sorting, the tonnage available for the mill would be 1,660,767 tons, averaging 10·1 dwt. per ton. During the year the reserve has been raised by 574,464 milling tons, and the average assay-value has increased by 1·7 dwt. per ton. It will be observed that the assay-value of the ore milled from July to December was less than the average of the reserve. This is due to the fact that the ore taken from the dump consisted largely of low-grade ore removed during development. James G. Lawn is consulting engineer, and E. A. Douglas is manager, having recently succeeded W. A. Krige.

Consolidated Langlaagte.—This company belongs to the Barnato group, and was formed in 1902 to acquire the properties of the Crœsus and Langlaagte Star companies, on the outcrop in the west part of the central Rand. In 1905 the shaft of the Star section intersected the Ferreira-Crown Reef dike at a depth of 1657 ft., and subsequent exploration by bore-hole revealed the fact that the Main Reef Series was 1100 ft. nearer the surface on the south side of the dike than on the north side. Accordingly a new system of development was adopted by means of two new shafts on ground acquired in 1908. Two years ago it was decided to replace the old 140-stamp mill by a new mill of 100 heavy stamps and 10 tube-mills, and the change was effected in October 1912. The report for the year 1913 now published shows that the company has at last reached a dividend-earning position. During the year, 498,174 tons of ore was hoisted through all four shafts, and 54,124 tons was taken from the dumps. After the removal of 5% waste, 523,100 tons, averaging 6·5 dwt. per ton, was sent to the stamps. The yield by amalgamation was 118,755 oz., and by cyanide 47,218 oz., a total of 165,974 oz., worth £705,057, being a yield of 6·35 dwt., or 26s. 11d. per ton milled. The working cost was £460,764, or 17s. 7d. per ton, leaving a working profit of £244,293, or 9s. 4d. per ton. An allowance has been made for depreciation of £50,330, and £23,416 has been paid as tax, while £47,300 was paid as interest on debentures and loans and in connection with the rearrangement of debentures. The shareholders received £95,000, being at the rate of 10%, and £113,553 was carried forward. Development has given excellent results, and the reserve has been more than maintained. The reserve on December 31 was estimated at 2,194,408 tons, averaging 7·4 dwt. per ton over a calculated width of 46 in. The directors are able to report that the finances have been placed on a sound footing. Loans and old debentures have been cancelled by means of an issue of new debentures amounting to £300,000 carrying 5½% interest, and by the issue of 217,321 shares to the Johannesburg Consolidated, the parent company. The share capital now stands at £950,000. James G. Lawn is the consulting engineer, having succeeded J. Harry Johns three years ago. Albert E. Payne is the manager.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Managing Director.

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CONTENTS.

STATISTICS.

STOCKS OF COPPER IN ENGLAND AND THE CONTINENT.
Reported by Henry R. Merton & Co. Tons of 2240 lb.

	Feb. 28 Tons	Mar. 31 Tons	April 30 Tons
In England	10,399	9,948	11,519
In France	1,576	1,791	2,310
Afloat from Chile	2,750	2,350	2,500
Afloat from Australia	3,800	3,800	4,000
In Rotterdam	3,300	3,200	3,400
In Hamburg	3,994	3,947	4,452
In Bremen	1,134	1,093	1,097
In other European Ports	700	600	575
Total European visible supply	27,653	26,729	29,853

AMERICAN COPPER PRODUCERS' ASSOCIATION'S FIGURES.
In Tons of 2240 lb.

	Production	Deliveries			Stocks at end of month
		Domestic	Foreign	Total	
Total, 1911	639,258	316,791	337,009	653,800	-
Total, 1912	706,052	365,920	333,212	699,132	—
April 1913	60,416	34,892	38,346	73,238	33,728
May	63,088	36,209	30,477	66,686	30,130
June	54,402	30,559	30,396	60,955	23,577
July	61,649	26,296	35,035	61,331	23,886
August	58,764	32,897	32,706	65,603	17,064
September	58,661	29,837	32,627	62,464	13,261
October	62,085	30,435	30,412	60,847	14,499
November	59,860	21,721	31,280	53,001	21,358
December	62,049	9,794	32,831	42,625	40,782
Total 1913	724,307	342,566	387,974	730,540	—
January 1914	58,826	21,409	39,266	60,675	38,933
February	54,715	21,244	37,455	58,699	34,949
March	65,023	31,184	39,983	71,167	28,805
April	67,634	28,315	36,761	65,076	31,363

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand	Elsewhere	Total	Value
	Oz.	Oz.	Oz.	£
Year 1912	8,753,563	370,731	9,124,299	38,757,560
April 1913	755,858	29,116	784,974	3,334,358
May	761,349	32,957	794,306	3,373,998
June	716,267	30,810	747,077	3,173,382
July	625,107	30,282	655,389	2,783,917
August	697,686	30,410	728,096	3,092,754
September	676,411	29,775	706,186	2,999,686
October	687,515	30,916	718,431	3,051,701
November	644,320	29,166	673,486	2,860,788
December	642,786	30,029	672,815	2,857,938
Year 1913	8,430,998	363,826	8,794,824	37,358,040
January 1914	621,902	29,851	651,753	2,768,470
February	597,545	28,716	626,261	2,660,186
March	657,708	29,093	686,801	2,917,346
April	655,607	28,270	683,877	2,904,924

COST AND PROFIT ON THE RAND

	Tons milled	Yield per ton	Cost per ton	Profit per ton	Total profit
		s. d.	s. d.	s. d.	£
Year 1912	25,486,361	29 2	19 3	9 11	12,678,095
Year 1913	25,628,432	27 9	17 11	9 6	12,189,105
January 1914	1,902,733	27 4	18 2	9 3	876,577
February	1,861,442	26 10	17 11	8 10	823,654
March	2,094,098	26 4	17 3	9 1	945,000

GOLD OUTPUT OF INDIA.

Year 1912	Year 1913	April 1914	Year 1914
£2,265,094	£2,299,315	£189,197	£759,698

PRODUCTION OF GOLD IN WEST AFRICA.

Year 1911 £	Year 1912 £	Year 1913 £	March 1914 £	Year 1914 £
1,069,442	1,497,179	1,634,700	131,392	383,423

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold mines	Coal mines	Diamond mines	Total
April 30, 1913	205,424	9,053	15,626	230,103
May 31	197,644	9,062	15,345	222,051
June 30	188,094	9,060	14,654	211,808
July 31	170,242	9,403	13,378	193,023
August 31	158,223	9,236	13,172	180,631
September 30	152,637	9,361	12,321	174,319
October 31	148,882	9,377	12,712	170,971
November 30	147,569	9,286	12,680	169,535
December 31	150,012	9,516	11,811	171,339
January 31, 1914	154,202	9,471	11,979	175,652
February 28	157,673	9,508	12,266	179,447
March 31	162,815	9,619	13,390	185,824
April 30	165,005	9,625	14,150	188,780

PRODUCTION OF GOLD IN RHODESIA.

Year 1911 £	Year 1912 £	Year 1913 £	March 1914 £	Year 1914 £
2,647,894	2,707,368	2,903,267	273,236	782,156

PRODUCTION OF GOLD IN WESTERN AUSTRALIA.

	Export oz.	Mint oz.	Total oz.	Total value £
Total, 1910	363,496	1,209,856	1,573,352	6,682,042
Total, 1911	160,021	1,210,447	1,370,468	5,823,522
Total, 1912	83,589	1,199,080	1,282,669	5,449,057
Total, 1913	86,255	1,227,888	1,314,143	5,448,332
January, 1914	9,762	102,261	112,023	475,840
February	8,493	94,812	103,305	438,809
March	1,173	91,446	92,619	393,418
April	8,774	90,233	99,007	420,553

OTHER AUSTRALASIAN GOLD PRODUCTION.

	1912	1913	April 1914	1914
	£		£	
Victoria	2,039,400	1,847,400	133,700	566,700
Queensland	1,484,160	1,118,610	79,040	303,080
New South Wales	702,129	635,703	35,967	187,964
New Zealand	1,345,115	1,345,131	66,337	431,141

NIGERIAN TIN PRODUCTION.
In tons of concentrate of unspecified content.

Year 1912 tons	Year 1913 tons	March 1914 tons	Year 1914 tons
2,532	5,032	502	1474

PRODUCTION OF TIN IN FEDERATED MALAY STATES.
Estimated at 70% of concentrate shipped to smelters.

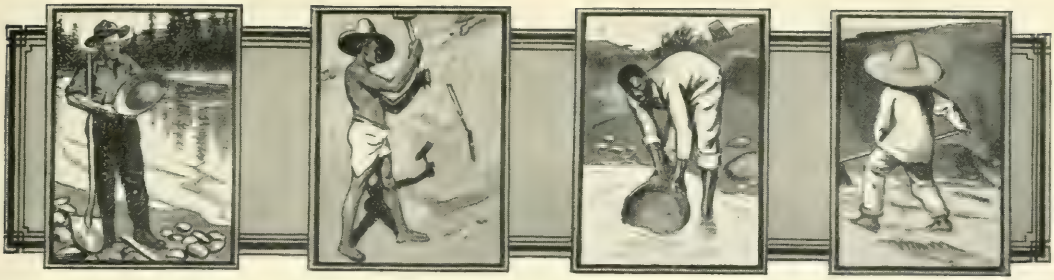
1911 tons	1912 tons	1913 tons	March 1914 tons	Year 1914 tons
43,967	48,250	50,128	3,839	12,377

SALE OF TIN CONCENTRATE AT REDRUTH TICKETINGS.

	Tons	Value	Average
Year 1911	6151¼	£702,599	£114 4 5
Year 1912	6492	£831,908	£128 5 6
Year 1913	6186	£744,268	£120 2 6
January 5, 1914	202¾	£18,743	£92 13 6
January 19	232¼	£23,045	£96 6 6
February 2	231	£24,054	£104 2 7
February 16	232¼	£23,824	£102 11 7
March 2	234½	£22,286	£95 2 9
March 16	214½	£20,726	£96 12 6
March 30	229½	£21,776	£94 17 8
April 14	193½	£18,251	£94 6 5
April 27	220½	£19,413	£88 0 11

EXPORTS OF TIN AND ORE FROM STRAITS AND BOLIVIA.
Reported by A. Strauss & Co.

	1912 tons	1913 tons	April 1914 tons	1914 tons
Metal from Straits to Europe and America	59,036	62,533	4,968	20,853
Metallic Content from Bolivia to Europe	21,149	24,843	2,850	8,754



REVIEW·OF·MINING

INTRODUCTORY.—Financial conditions, in so far as they affect the mining market, continue unfavourable. Since we last recorded the trend of events there has been a crisis in Ulster and another in Mexico, but neither contributed to a final solution of disturbing problems. In Mexico, American intervention is only delayed. Until decisive action is taken, all business will be suspended. Meanwhile, the general closing-down of mines controlled by Anglo-American companies is causing an exodus of technical men, and the threat to destroy the oil-wells near Tampico is causing anxiety in London and New York. Bad financial conditions in Brazil and the Argentine continue to intimidate the bourses of the Continent, notably at Paris and Brussels. At New York, railway finance is a disturbing factor, intensifying the anxiety caused by Mexico. In the mining departments themselves, there is a good undertone. Rand shares show ability to resist further depression. Rhodesian and Nigerian shares are neglected. Russian issues have fluctuated on Russian selling and risky option dealings, but nothing unpleasant has happened. Broken Hill is cheerful. Interest in Canadian mines is fed by sundry new flotations not too well recommended. The drought in India can be set against the beginning of the rainy season in Nigeria.

TRANSVAAL.—The output of gold was practically the same in April and March, allowing for the difference of one day in the length of the months. On the other hand, the increase of 2190 in the supply of native labour is a good feature, when compared with the loss of 2039 in the corresponding month last year. The total available is, however, only 165,005 as against 205,424 a year ago.

The presentation of a petition to General Botha urging the maintenance of the colour bar in skilled work underground indicates the fear of the white miners on the Rand that their occupation as supervisors is seriously threatened by the increasing aptitude of the natives.

The text of the report by Surgeon-General Gorgas has arrived and is being read with interest. He commends the methods for allaying dust and suggests sundry experiments. Meanwhile, he considers the chief sanitary defect to be the housing of the natives, too much crowding, and artificial conditions. He recommends the erection of villages and the introduction of women and children, establishing normal homes. We discuss the subject on another page.

The speech of Mr. Walter McDermott, as chairman of the Consolidated Mines Selection Co., was admirable in its lucidity and frankness. Developments at the Brakpan were better than was anticipated for the first two years, and worse than was estimated during the last two years. A not unusual optimism was followed by a compensating depression. That is the story. Mr. McDermott told it in technical phraseology marked by an accuracy unusual at company meetings.

In our reference to the Brakpan reserves last month, we were in error. The report does not give the "unpayable ore" as an asset, but to indicate the proportion of developed ground that is excluded from the reserve of "payable ore." Of the total 'ore' developed to date, 62% is profitable, and 38% is banket not available for milling.

Sir George Farrar, as chairman of the East Rand Proprietary, assured the shareholders of that company at the annual meeting that "profitable mining on the property would not cease within the next twenty years." That is the official estimate of the life of the mine; and it is worthless, until the amount of profit is specified. It would be a poor consolation to shareholders if the East Rand earned £5000 per annum ten or twelve years hence. If Sir George cannot make a more definite statement than that, he had better say nothing about the life of the mine. Meanwhile, we may remind our readers that a definite estimate by an independent engineer appeared in *The Mining Magazine* of July, 1913.

The labour disturbances of last year came at an inopportune time for the Crown Mines, for the scarcity of native workers during the latter months prevented the engineers from reaping the full benefit of the re-arrangement of the surface and underground operations. The great consolidation of 1909 was projected with the object of increasing the output and cheapening the cost. The re-organization occupied a longer time than contemplated. The results of the first half of 1913, according to the reports of Messrs. H. Stuart Martin and R. C. Warriner, fully proved the success of this policy of concentration.

Rich ore is still being stoped on the Rand. We note that the reserve of the Meyer & Charlton includes 207,000 tons of ore in the Main Reef Leader that averages an ounce (19·91 dwt.) of gold over a full stoping-width (46 inches). Indeed, this part of the mine contributes 43·8% of its assured resources. This property affords one of the pleasing features of Rand mining. During 1913 the reserve was increased from 363,500 tons of 11·3 dwt. ore to 471,800 tons of 11·7 dwt. ore. Meanwhile the working cost has been reduced slightly (9·8d. per ton) to 18s. 3d. per ton, despite the sundry unpleasantnesses that hindered progress during the past calendar year.

The annual report of the Cinderella Consolidated shows how unfortunate the company was in having to shut-down in November last at a time when the new Central shaft was so near to intersection with the lode and connection established with the Main Incline. A working cost of 27s. 5d. per ton against a yield of 26s. 8d. explains the difficulty in raising further capital. Ever since the development of this property was undertaken on a large scale in 1910, operations have been hampered by the lack of access to the surface. The Government regulations limit the number of workers underground when there is only one outlet. Nor was the company fortunate in its negotiations for a temporary second outlet with its neighbours, the East Rand Proprietary. It was expected that, when the Central shaft was completed and further development done, it would be possible to expand operations to the level originally contemplated, that is, to mine 100,000 tons per month, as against a maximum present capacity of 22,000 tons. At the time of the consolidation it was estimated that the cost per ton when working on the large scale would be 17 to 18 shillings.

The Messina copper enterprise continues to develop satisfactorily. The output of the concentrating plant is expanding steadily, being 1332 tons averaging 40% copper during March as compared with 1069 tons of similar tenour in February. The plant also produced 401 tons of jig middling averaging 10% copper. The reverberatory furnace produced 97 tons of 65% matte from jig middling. The concentrate and matte is at present being shipped to England for sale. The estimated profit on the March production was £19,400.

RHODESIA.—The output of gold continues

to increase, the total for March being again the largest recorded. This is due to the new producers: the Shamva, Cam & Motor, and Bell Reef.

The Cam & Motor report for April bears out our expectation that the metallurgical scheme would meet with difficulties. The extraction of 57%, as against the anticipated 85%, is most disappointing. It is announced that the plant cannot treat the estimated 500 tons daily, nor is it capable of making a satisfactory extraction; therefore, some costly additions will be required, and as some of them will come from America a considerable delay is inevitable. All forecasts of cost are in the air, until the treatment has been satisfactorily adjusted.

The Globe & Phœnix annual meeting was marked by the usual squabble over directors' fees. Apparently some of the shareholders have not learned yet to regard the salary of a director as a minor matter compared with his competence and trustworthiness. A half-yearly meeting is to be held at Edinburgh, so as to give the Scottish shareholders an occasional chance to air their ideas and grievances. The noble chairman is likely to earn his salary.

A cablegram from the Eldorado stated that the main lode had been cut on the 13th level, where it showed coarse gold and was otherwise well mineralized. Later news is that the ore assays only $10\frac{3}{4}$ dwt. across 11 feet, which shows how delusive visible gold can be.

The chairman of the Lonely Reef, Mr. C. F. Rowsell, must have appreciated *la malice de choses* when he presided at the recent annual meeting, and explained the impoverishment in the deeper workings of the mine, which was the same mine as had been asserted by him two years ago to afford evidence of progressive enrichment in depth. It is curious that a director of such experience should have made an error so elementary. Now he has to acknowledge that the ore on the 8th level averages 32 dwt.; on the 9th, 30 dwt.; on the 10th, 20 dwt.; and on the 11th, 16 dwt. Well, we are not going to argue progressive impoverishment even on these figures, but the Lonely pendulum has certainly swung violently the other way. The mistake, of course, was in forecasting either persistence or enrichment until the zone of oxidation had been traversed.

WEST AFRICA.—The output of gold in March shows no noteworthy increase, and is considerably less than in the corresponding month last year.

The misleading character of much of the information sent from Nigeria is exemplified by the reports issued at intervals concerning the Abu tin property, giving high results from washing tests. These now prove, according to Mr. J. F. Balfour, to have represented only 559 tons of tin concentrate, an amount quite out of proportion to the expectations held forth by the previous information furnished to the shareholders.

The Bisichi report is a compact document, and contains a good deal of pertinent information. As against the output of 370 tons of black tin in 1913, the property is expected to contain a further 4300 tons available for extraction. An output of 400 tons per annum is anticipated.

The Jos dredge treated 17,500 cubic yards in April, and recovered 4·55 lb. black tin per yard. As the dredge worked only two-thirds of the full time, it is likely to continue the evident improvement in capacity, the maximum being rated at 24,000 cu. yd. monthly.

AUSTRALASIA.—The Waihi report is a record of disappointment, no ore having been found during the year on the Martha or main lode of the mine. The ore reserve is given as 764,732 tons, which compares with 750,634 tons a year previous. But these estimates of tonnage have no significance, since the grade of the ore is not stated. A great deal of the new ore-bearing ground is relatively poor and patchy. The ore in arches and pillars is estimated separately, and in this respect the re-

TIN MINING AT

port sets a good example to many companies operating on the Rand. It is frankly explained that much of the ore supporting the levels and all of that around the shafts cannot be removed until the mine is abandoned.

Since the New Zealand labour trouble of eighteen months ago, Mr. W. F. Grace, the manager of the Waihi Grand Junction, has been introducing many mechanical improvements with the object of making the limited supply of men go as far as possible, and all the ore is now being broken by stope-drills. Nevertheless the mine is still undermanned, for the prolonged strike scattered the mining community, and the difficulty of collecting competent men once more is great. As regards developments, excellent ore has been disclosed on the sixth level in the Empire lode and foot-wall leader, but the Royal lode has been disappointing. It has not been possible to do any work on the other lodes.

It has been found necessary to suspend milling for five weeks at the Great Fingall pending the timbering of the levels and filling of the stopes in the upper portion of the mine, where a serious caving along the hanging wall was imminent.

Our Melbourne correspondent writes concerning the deal for the Port Pirie smelter, and discusses the Mount Elliott scheme.

Pathetic interest attaches to the death, on May 4, of Mr. Andrew Haes, the chairman of the Great Cobar company.

CANADA.—Systematic diamond-drilling has been started at the Hollinger mine, the shaft of which is now down 525 feet. The shares are steady at about £3, and we understand that those in control consider this valuation to represent the assured realizable assets, leaving the interest on the capital involved to the speculative chances of mining. This is reasonable. Our own experience when visiting this mine, two years ago, was that the management was particularly courteous and frank in giving information. Any engineer visiting Porcupine can count on access to the mine and even to being shown the assay-plans. Such a policy speaks for itself.

On April 21 it was announced that the Tough-Oakes shaft on the No. 2 vein had been

THE BISICHI, NIGERIA.

sunk to 300 feet, where the vein was 12 inches wide assaying 3 oz. 19 dwt. per ton. Work on the No. 3 vein also shows some rich ore. Meanwhile we hear that prospecting on adjacent claims has been unproductive of noteworthy results, and that Canadian interest in the Kirkland Lake district is slight. The shares of the Tough-Oakes and of its parent promoting company remain high. While the mine is a rich little property, the official estimates of future profits are unwarranted. If a mine contains a supply of ore estimated to yield £150,000, it is unreasonable to assume a revenue of £150,000 per annum. Yet this is the latest forecast issued from the office of the company. Should the present small and irregular orebody persist without impoverishment to a further depth of two or three hundred feet, it will afford grounds for congratulation to all concerned.

The Northern Light Power & Coal Co. was formed to secure title to coal deposits and operate a power-plant near Dawson. The prospectus stated that the company had contracts for power such as would assure large profits. Thereupon, the plant was erected at great expense, but the contracts failed to yield the revenue expected. The largest alleged defaulting contractor, the Klondyke White Channel G.M. Co., was sued for default. This suit has been dismissed by the British courts, and the company is now saddled with an expensive plant, which has been leased to the Canadian Klondyke Mining Co. for a rental of £10,000 per annum. This is a meagre return on £3,000,000 in shares and £2,000,000 in bonds.

UNITED STATES.—In Colorado the refusal of Mr. J. D. Rockefeller, Jr., the controlling factor in the Colorado Fuel & Iron Co., to recognize the labour-unions has led to a bitter and sanguinary outbreak at the Walsenburg coal mines, culminating in the intervention of the Federal government.

The report of the Natomas Consolidated for 1913 illustrates some of the misfortunes that may befall a gold-dredging enterprise. Two dredges sank, inordinate repairs spoiled the record of two more, excessive clay impeded digging by four others, and so forth. One dredge only, out of 13, exceeded the estimate of profit. The final result was a gross yield of 9·42 cents per cubic yard, a cost of 5·354 c., and a return of 4·066 per yard. The average profit for the year diminished by 0·657 c. per yard, on the 24,407,148 cubic yards of gravel dredged. The dredging time averaged 82·3% for the whole fleet during the year. In his report Mr. C. M. Rolker refers to the discrepancy between the yield and his original estimate. The returns have been 15% less on the gross output, or 27% less on the net, than the boreholes indicated. Mr. Rolker did not drill the ground himself, accepting the results of drillings made by Mr. Newton Cleaveland, for Mr. W. P. Hammon; he was informed by them that the figures recorded on the map were the original yields after 15% had been deducted, as a reasonable margin of safety between drilling and dredging. When a discrepancy became apparent, a new set of holes was drilled in 1912, so that in 1913 it became clear that Mr. Rolker was correct in asserting that "extraction results did not bear out" the statement of Mr. Cleaveland that the usual allowance had been made on the drilling results. It only remains to add that at the time when the company was floated in London, by the Hirsch Syndicate, a report was made by Mr. W. P. Hammon, one of the vendors, endorsing Mr. Cleaveland's estimates. This is simply another example of the folly of asking vendors for opinions on a mine and then solemnly quoting them in a prospectus as if they were serious appraisals.

MEXICO.—We refer elsewhere in this issue to the latest developments. On April 23 the American Smelting & Refining Company announced that it had given orders for the cessation of work at all its mines and smelters, with instructions that all its American employees should leave the country immediately. This was followed by the suspension of work at a number of mines, the ore of which is usually consigned to the American smelters. Among the mines reported to have shut-down are the Buena Tierra in Chihuahua, all the mines of the El Oro district, and several at Guanajuato. At Pachuca the Santa Gertrudis mill is shut-down. This general exodus of Europeans will involve the closing-down of most of the mines, mills, and smelters belonging to foreign companies. It is unavoidable until such time as some semblance of government is restored.

It is reported that G. E. Williams and C. B. Hoadley have been killed, while Mr. Walter Neal was wounded, at the El Favor mine, in Guadalajara. S. H. A. Green is stated to have been killed at San Mario.

INDIA.—The Kolar gold mines are suffering from a shortage of electric power, owing to the absence of rain and the consequent decrease in the flow of water at the Cauvery falls. Development has been generally suspended, and the milling capacity has been reduced. In the case of the Balaghat the mill is entirely closed.

RUSSIA.—The Tanalyk smelter has started, with one furnace, having a capacity of 150 tons daily. The converters will not be in blast for another two months. Some highly satisfactory developments are reported from the big gossan at the Semeonovsky mine from shallow shafts, this oxidized ore being proved for 600 feet in length, and from 12 to 78 feet in width, assaying 8½ dwt. gold. It contains the barite that is the sign of pyrite within the sulphide zone.

At Kyshtim the new gas-fired reverberatories will be in operation during the summer. Underground developments continue as before, the actual blocking of ore being confined to a year's supply, while diamond-drilling continues. A third deep hole is being sunk on the Koniukhoff mine to cut ore at 1600 feet on the dip.

At the Ridder mine, of the Russo-Asiatic Corporation, the old workings have been unwatered, and are being cleared preparatory to systematic sampling. Four drill-holes have now intersected the orebody at a depth of 200 feet on the dip below the old workings, which extend to about 150 feet below the surface. These holes have tested the orebody on its strike for 500 feet, proving that the solid sulphide ore has a true width of 18 to 112 feet, of the average metal content previously recorded. Complete details concerning the gold-bearing hornstone have not been received. This part of the lode, it has been found, is amenable to concentration as well as cyanidation. Good progress has been made with the erection of an experimental concentrating plant. Work is being conducted satisfactorily at the Ekibastus coal mine, from which the Ridder will derive its fuel, and the railway from the coal mine to the river is being rehabilitated for early use. At the Nerchinsk properties the diamond-drills are due to arrive, the staff being already on the ground.

On the Russian Mining concession in the Altai, only preliminary work is being done, namely, the unwatering of the mines and some cross-cutting on the upper levels. Diamond-drills are on their way for use in a campaign of systematic prospecting.

VARIOUS. — Dredging re-commenced at Pato on April 25, the rainy season having begun. We have received a copy of a letter addressed by Mr. H. S. Derby to the Pato Mines Co., protesting against the transfer of the San Francisco property to a new subsidiary, it being Mr. Derby's contention, as director and shareholder in the Pato Mines (Colombia) Ltd., that the San Francisco property was tested and bought with the money of the Pato company. We confess that the subsidiary process has been carried far in this case, the Nechi being the son of the Pato, and the grandson of the Oroville.

AT THE BAWDWIN MINE, OF THE BURMA CORPORATION.

We refer elsewhere to the Bawdwin mine of the Burma Corporation, formerly the Burma. It appears that the ore deemed so refractory is saleable to the European smelters, who have already taken 7000 tons, and are willing to enter into contracts for a larger tonnage. The Burma Corporation owns 97·2% of the issued share capital of the Burma Mines, Limited.

EDITORIAL

RAND mining companies, despite the magnitude of their revenue, seem indisposed to issue reasonably good maps and sections with their annual reports. Most of those that we see are crude lithographically, and, therefore, confusing to such as may study them for the purpose of information, which should be their function.

ON April 14 the strike at the copper mines of Michigan—usually known as the Lake Superior region—was settled. Thus ends a long and costly interruption to industry. We outlined the causes of the quarrel in our January issue, under the heading of 'Strike Investigations.' We note now that the mine operators have been successful in refusing to recognize the Federation of Labour, an anti-social conspiracy, but they have conceded the 8-hour day, a minimum wage of $3 per diem, and better working conditions. We regard the result as satisfactory. It will promote the prosperity of the industry and the well-being of the workers. A letter on the subject, by Mr. P. B. McDonald, appears under 'Discussion.'

ENGINEERS reporting on Nigerian mines have developed a pernicious habit of expressing the resources of the tin areas in terms of ore containing a given percentage of tin. The concentrate to which they refer is an artificial product; it is not 'ore,' but the result of sundry operations on the 'ore,' which, in this case, is tin-bearing alluvium. Moreover, they omit, particularly in cablegrams, to state the quantity of crude material from which this concentrate is to be derived; they do not give the number of cubic yards to be washed in order to extract the given tonnage of black tin. Nor, usually, do they mention the cost, per yard of gravel or per ton of black tin, to be incurred in the precedent operations. Technically, such statements, therefore, are incorrect, and as they are used by some engineers that have every honourable desire to represent the facts correctly, we hope that the practice may be discontinued.

AT the request of a deputation representing Members of Parliament of all shades of political opinion, the Government has decided to reconsider its decision to give no support to the Panama Exposition. The abstention of this country has been misinterpreted in America. Any possible cause of misunderstanding between the two branches of the English-speaking race should be removed, especially in these days when their community of interest is so apparent in regard to the pacification of the unruly neighbour on the South.

LONDON is to be the place of meeting for the International Congress of Mining, Metallurgy, Engineering, and Economic Geology in July next year. This congress meets at intervals of five years, the last having been held at Düsseldorf in 1910. Hence the choice of London for the meeting next year is a matter of considerable interest to those within the sound of Bow Bells. Arrangements are in the hands of a representative committee. While our metal-mining industry is relatively small, it has historic associations of no mean kind. After our visitors have made excursions to one of the iron and steel centres in the

Midlands and to one of the Welsh coalfields, they can visit the Kent coalfield, which promises to play a great part in the industrial future of these islands. Cornwall cannot be omitted, for it is picturesque in scenery and romantic in history. The oil-shale industry will be a pleasant excuse for going to Scotland. But our chief exhibit in the mining way, after all, is Throgmorton Street and the other purlieus of this City whence go the vast sums of capital that irrigate the waste places of the earth and develop mineral resources in every corner of the habitable globe.

COINS are rarely associated directly with the mines that yielded the metal for them. A few days ago we saw some silver dollars coined by the rebel government of Chihuahua, Mexico. The silver came from the El Rayo mine, and it had been stamped by a punch stolen from the San Francisco del Oro. Speaking of that well known depository of refractory ore, it is said that the rebel Governor of Chihuahua, General Chao, when commandeering the ore from sundry mines, asked the manager of the San Francisco del Oro what sort of ore his mine produced, on which the General was told that the ore contained many metals, and that if he could treat it successfully he would confer a service. It appears that the ore stolen from the mines of the Parral district is treated at the Alvarado mill, which has been requisitioned by the rebel executive for that purpose. We have also seen the copper coins, of two centavos, made from the metal of the Parral Electric Power Co's. line. These performances, it is hoped, may shortly be rendered infrequent.

THE SELECT COMMITTEE of the House of Lords appointed to investigate the charges against Lord Murray has done a public service in expressing a strong opinion concerning the impropriety of men in office engaging in speculative transactions. Even when, as in the case under review, the personal honour of the office-holder is not called in question, it is apparent that such a conflict of interest is assumed as undermines public confidence. This is true whenever private business is allowed to cross public trust. We are all human, and the wise thing is to recognize the fact, by taking care that the duties of a trustee may suffer no interference from the operations of a speculator. This applies to directors of companies and to editors of newspapers.

DURING the past two years, our subscribers in Mexico have received the Magazine only occasionally, owing to the utter disorganization of the postal service of that country. So many copies have been returned to us, endorsed with real or feigned reasons for non-delivery, that we have had it in mind for some time to cease despatch, and to advise our supporters accordingly. The precipitation of hostilities between the United States and Mexico last month has made it necessary for us to adopt this course. We are therefore sending letters to subscribers announcing our intention to hold their copies until we hear from them. Probably few of these letters will reach their destination, so we take this opportunity of communicating with such subscribers as are outside the present scene of conflict, in order to explain the position and to ask for their further instructions.

OIL EXPLOITATION in Alberta will, we hope, prove a productive industry in the near future, but such favourable indications as may exist are already being exaggerated grossly in order to lure the unsuspecting into the purchase of scrip. It appears that Mr. Cunningham Craig made an inspection, for the circumspect opinions appearing in his report are being sandwiched amid a mass of flamboyant flapdoodle concerning the assured prospects of the oil-bearing territory. The gushers are there already, in verbiage, not oil. Assurances of success are offered by mayors, aldermen, and business men, having no technical knowledge of the matter. One qualification for a guarantee of a square deal is "gentleman and scholar," which is appended to the name of the secretary and treasurer. It is a noble and honourable description; doubtless it is deserved; but alas! it indicates no aptitude or experience in the technical business of finding oil. Some of the worst messes in mining have been perpetrated by gentlemen and scholars. What is needed is a mining engineer with special experience in the business involved, and if he be also, as often happens, a scholar and a gentleman, so much the better. Then skill will be joined to scruples and the appreciation of facts to the sense of honour. Meanwhile, intending shareholders had better obtain the advice of persons competent and independent.

NEWS is to hand by cable to the effect that the United States Appeal Court for the Western Circuit has reversed the decision of the Montana court in the case of Minerals Separation v. J. M. Hyde. The result of this judgment is to render invalid the patents of the Minerals Separation company in America. We confess to a feeling of regret that, through the inevitable contradictions of procedure in patent litigation, such conflicting conclusions should terminate the two recent legal actions in the United States and Australia. From the point of view of the average mining engineer and metallurgist, it seems the height of absurdity that the Minerals Separation patents should be maintained in Australia and rejected in the United States. Such illogical conditions only act as irritating interferences with general progress. The reason for these divergent results is seen on an examination of the nature of the litigation. In Australia the Elmores attacked the Minerals Separation patents as infringements of their own, and were defeated. The validity of the Minerals Separation patents was, of course, only maintained in their relation to those of the Elmores, and their soundness on general grounds could only be assumed from the absence of any other disputant. On the other hand, the Minerals Separation company was the attacking party in the United States, and the defendant, Mr. James M. Hyde, was in the position to impugn the Minerals Separation patents. In our issue of September last we outlined the opinion of the Montana court, where the Everson and Froment patents failed to impress the judge as anticipations of the Minerals Separation's claims. In the hearing of the appeal fresh evidence was presented by Mr. Hyde, and it appears that arguments based on the patent granted to Edmund B. Kirby in 1904 caused the modification in the judicial opinion. We reserve our detailed account of the judgment until the arrival of fuller information from the theatre of war.

PHTHISIS has been fully considered in its relation to the white supervisors and natives employed in the mines of the Rand, but the effect of the disease on members of the engineering staff has received scanty mention, except in our issue of June last. It is a fact, however, that the prevalence of phthisis, especially in its tubercular phase, despite remedial measures, is having a lamentable effect among those responsible for the direction of operations underground. Those who make the best superintendents and managers are the men who have served their apprenticeship as samplers and surveyors, and have worked their way up to the chief posts by years of conscientious service. These are exactly the men who are apt to be the victims of silicosis and of its sequel, tubercular phthisis. This fact is recognized in South Africa, but not outside. When known, it should cause young men to think twice before undertaking to go through the local preparation necessary for the higher appointments. As one of them said to us: "If I were offered a mine captain's job tomorrow at £100 per month, I should certainly refuse it, because of the danger of my lungs becoming weakened or infected."

The Mexican Crisis.

The United States is trying to escape her destiny. The episodes of the past four weeks represent the cumulative effect of precedent events. On April 9 a small party of American marines, landing at Tampico to obtain supplies, was arrested by a squad of Huerta's soldiers. Subsequent apologies were considered inadequate; the American admiral demanded that the flag should be saluted with special ceremony; the Huerta government asked for a guarantee that a return salute would be forthcoming. The American government declined to give any such guarantee; Huerta refused to give the required salute without the guarantee. Thereupon the Atlantic fleet was hurried to Vera Cruz and on April 21 a landing was effected, the custom-house seized, and the town occupied after street fighting in which numerous casualties ensued. It looked as if all the factions in Mexico were about to unite against foreign aggression, when, on April 24, the diplomatic representatives of Argentina, Bolivia, and Chile offered their services as mediators; these were accepted; and at the time of this writing a lull has supervened. But a state of war persists. Warlike preparations continue and causes of irritation are numerous. The Tampico affair was merely one of a great many acts tending to hurt the dignity of the United States and to injure its citizens in Mexico. As far as can be ascertained, Huerta's position as President is precarious, but his removal from office would only mean another cat-and-dog fight between the military adventurers and brigands posing as political leaders. The fact is that revolution and counter-revolution are normal in Mexico; the peace that marked the later period of the Diaz regime was abnormal; from the time when Spanish domination was finally rejected to the beginning of the Diaz despotism—1821 to 1876—no less than 52 military adventurers, officially called 'presidents,' came and went their ensanguined way. One president per annum was about the average before Diaz, and that average holds good now. A country so misgoverned and in such a state of savage unrest cannot maintain its independence next-door to another country in a highly advanced stage of industrial civilization. Interference is inevitable. The Americans do not covet further territory nor do they want to risk a fit of political dyspepsia by absorbing the Spanish-Indian population south of the Rio Grande, but they cannot escape the responsibilities of their own political declaration—the Monroe doctrine—by virtue of which they are under compulsion to assume police duty over their disorderly neighbour. Mexico must be Egyptianized by the United States. The American frontier is now at the Panama Canal, and the destiny of the American people is to exercise suzerainty over all the territory extending from the 49th parallel of latitude to the Panama Canal Zone.

The Parting of the Ways.

The Institution of Civil Engineers has taken steps to oppose the grant of a charter to the Institution of Mining and Metallurgy. Having itself long ago obtained such measure of official recognition, the older society undertakes to block the bestowal of a similar privilege upon its younger associate. The senior organization was formed in 1818, that is, at a time when only two kinds of engineering were recognized, military and civil. The Civil Engineers are the civilian engineers. Their organization included those concerned with various branches of engineering that have been developed on a grand scale since the Institution of Civil Engineers was founded, and having only this in common : they are not military. But mining was overlooked. In their protest the Civil Engineers now claim that mining engineering was included within the scope of their charter, but we have read the definition in that document, and we find no mention of mining, no allusion to that ancient art, which flourished, we are glad to say, long before 1818. When, however, modern science became applied systematically to the art of mining, a new branch of technology was evolved, and with it there came the need for an organization to include the professional men devoted to this particular branch of non-military engineering. Thus eventually in 1892—22 years ago—the Institution of Mining and Metallurgy came into being. Not prematurely, but in the ripeness of time ; not as a rival to the older society, but to supplement it ; to do for the mining and metallurgical engineers what the society of general civilian engineers had not done and could not do. No purely metalliferous mining engineer is on the council of the Civil Institution, nor is there the slightest chance that such a practitioner would ever be elected to the council. The Mining Institution has made it clear that it devotes itself only to mining other than coal and only to metallurgy other than iron. It is claimed that 780 engineers engaged in mining and metallurgical work are on the roll of the Civil Institution, and that 94 of the civil engineers are on the roll of the Mining Institution. Statistical evidence can be misleading. Fully acquainted as we are with the men active in mining engineering, we can say that no civil engineer not a member of the Mining Institution enjoys any standing as a mining engineer in non-ferrous metal mining, that membership in the Civil Institution indicates no qualification for the special work of managing and appraising non-ferrous metal mines, that a report on a non-ferrous mine by an M.I.C.E. has no more value in business than that of an architect, unless he can also show the credentials of the Mining Institution. Of course, a big majority of the 780 civil engineers said to be engaged in mining and metallurgical work are in the iron and coal industries. Of the 94 men who are said to be on the roll of both societies, it is fair to say that only a score can claim full membership in both ; most of them are members of the Mining and only 'associate-members' of the Civil Institution. Not one of them is regarded as having special qualifications for mining on account of his civil affiliation, and most of them retain it for the sake of a sentiment that the present action of the Civil Institution should effectually destroy.

Another claim is phrased thus : "In order that the central institution may retain the influence which has enabled it to promote the attainment of the present position occupied by engineers, it is submitted that the distinction of incorporation under royal charter should continue to attach to it alone so far as the engineering profession is concerned." This is a gross assumption. On the contrary, the Civil Institution has done nothing whatever to promote the improved position now occupied by mining engineers ; its policy has been either to ignore the mining engineer, or to treat him as if he were a poor relation. Only at rare intervals do the publications of that society recognize metal mining ; on the whole, the technical literature it publishes is barren in matter useful to the metallurgist.

The time has come to ask the members of the Mining Institution to give practical evidence of their belief that their membership is a sufficient qualification for the duties of a mining engineer. Those who have retained membership or associateship in the older society ought to resign from the Civil Institution, now that it has gone out of its way to injure the organization devoted so successfully to the best interests of the mining profession. Now is the time for a strong expression of loyalty to our institution, which we trust will soon be in receipt of the royal charter recognizing it as the foremost British society of metalliferous mining engineers and metallurgists. We count confidently on one effect of the inimical action of the Institution of Civil Engineers, namely, the evoking of such a feeling of support for the Institution of Mining and Metallurgy as to cause the present episode to be associated hereafter with a final recognition of the solidarity of the mining profession.

Burma Corporation.

In August we referred to the discovery on the Bawdwin property of the Burma Mines company as "one of the largest orebodies uncovered during the last decade," and we gave such particulars concerning contents and dimensions as were ascertainable at that time. The original company was formed in 1904 by Mr. M. F. Kindersley, together with friends in Burma, to acquire silver-lead mines and slag-heaps near Lashio, in the Northern Shan States. This company was reconstituted in 1906 by Bewick, Moreing & Co. The oxidized ore had been worked by the Chinese, and a huge open-cut testified to the probable size of the orebodies. These former operations had been confined to the extraction of the silver-lead ores, especially the cerussite, leaving the zinc and copper mineral alone. A railway and a smelter were built by the English company for the treatment of the old slag, the profits from which were consumed in the development and equipment of the property. Various efforts were made to gain entrance into the abandoned workings and to investigate the lode in the bottom, but all of them failed on account of excessive water, until in 1913 a drainage adit was advanced under the old excavations. Soon a big lode was disclosed. Meanwhile the smelter had been moved from Mandalay to Nam Tu, near the mine, and additional funds became necessary. Up to that time the Burma Mines had raised about £400,000 for working capital; when re-organization became imperative and the Burma Corporation assumed control, an additional £50,000 was obtained; finally, on May 6, a sum of £100,000 was provided and arrangements were made looking to a further £200,000. Thus £750,000 will have been appropriated for the purpose of developing and equipping this interesting deposit. When the lode was cut it proved to contain mixed sulphides of a most refractory nature, so that profitable extraction appeared at first to be dependent on patient experiment and laborious research. The supply of slag, which had been the main resource of the company, could last only another year. The enterprise seemed destined to a period of wearisome incubation. But it happened otherwise; for the continental smelters were able to utilize the ore in its crude state, as a suitable admixture with other material, and they have now contracted to purchase the output after it has been hand-picked, so as to give the company a profit of over £2 per ton. Systematic exploration has disclosed a definite ore-channel, 350 to 500 feet wide, which has been traced for 8000 feet in length, although as yet actual development has been limited to the northern half of this lode. The ore is divisible into three classes, according as zinc, lead, or copper predominates. The zinc-lead ore averages 30% zinc, 26% lead, with 23 oz. silver per ton. This, with the combined metals valued at £39, will yield a profit of £2 per ton. By hand-picking the profit can be raised to £2½ per ton. The lead-zinc ore assays 24% lead, 14% zinc, with 17 oz. silver. This can be jigged so as to yield a profit of £2 per ton also. The copper-silver ore, assaying 15% copper and 7½ oz. silver, can be smelted on the spot, at a probable profit of £3 per ton, but the beneficiation of this product will be postponed for the present. It is estimated that each 100 feet in depth on the ore-shoots now disclosed will yield a total of 500,000 tons of a gross value of £6,500,000. But this gross value is enormously reduced when translated into revenue, as we have seen, for the official estimate of profit is from £2 to 2½ per ton only. The tonnage already assured, to a vertical depth of 200 feet below the adit, is 1,154,000. Another adit has been started to intersect the ore-channel 500 feet deeper. In order to equip the mine, re-align the railway, erect a power-plant and concentration-plant, and complete a systematic scheme of development during the next two or three years, the share-issue of May 6 was made by the Burma Corporation. It proved highly successful. This is a tribute to the confidence felt in the management. We endorse that appreciation. In asking for further working capital the board of directors submitted the report of a technical committee consisting of Messrs. R. Gilman Brown, Theodore J. Hoover, A. F. Kuehn, and E. Heberlein. The last name suggests the participation and support of the Metall Gesellschaft of Frankfurt. This committee, of course, consists of men all of whom have special qualifications for the problems involved, and their mutual co-operation provides a factor of safety over-riding the personal equation of any single one of them. The mining and metallurgical engineers mentioned are also on the board of directors, together with Messrs. H. C. Hoover, R. Tilden Smith, and F. A. Govett. The board manifestly is a strong one and well adapted for the important work in hand. The frankness with which ore having a paper value of £11 to £14 is shown to represent a present profit of only £2 to £3 per ton is highly commendable, for the combined assay-values of such complex ores can be, and usually are, widely misinterpreted. We feel assured that the policy of the management will be further sustained, so as to check the wild speculation that seems to be the customary prelude to promising enterprises, rendering them eventually a counter for gambling instead of the basis of honourable industry.

Central Mining.

This corporation's annual report is not only interesting on account of the magnitude of the business involved, but also by reason of the technical data recorded by the consulting engineer, Mr. H. F. Marriott. As to the last, we are glad this year, as last year, to express our keen appreciation of his effort to give information in terms that cannot be misunderstood. He goes beyond the inconclusive 'working profit' and states the 'net resultant profit,' which is the net cash profit available for dividend purposes, or for re-investment in improvements to provide increased capacity, or in the purchase of more property. Of course, this interpretation of 'profit' is a long way ahead of the ordinary careless usage, but it is weakened by the inclusion of capital expenditure. Once a mine has consumed its original working capital, all expenditures on plant and equipment should, we submit, be considered as subtractions from profit. No large mine can continue in operation without incurring such expenditure for plant and machinery, which inevitably cease to be an asset whenever the life of the mine is ended. Therefore if the difference between revenue and current expenditure, including taxes, is 13s. per ton, this sum does not represent the ultimate profit if 3s. out of the 13s. is spent on new plant. The actual, real tangible profit is only 10s. per ton. We present this view of the matter to Mr. Marriott. He may not be able to accept it, for such matters are largely in the hands of directors, guided more by auditors than by engineers. That is why most mining accounts express the conventions of the period, rather than a scientific recognition of basic conditions. However, as we have already suggested, the Central Mining report is so much in advance of the average annual statement as to furnish an example. It is a weighty example, for the Central Mining's business is impressive. For instance, the mines under its control yield 34·7% of the tonnage and 53·2% of the dividends forthcoming on the Rand. Nor are its energies restricted to South Africa, for the Gold Coast, East Africa, Colombia, California, and Trinidad are beneficiaries of the corporation's financial energies. However, the chief assets are in South Africa, where industrial troubles have been an adverse factor during the past year, causing a depression expressed by an appropriation for depreciation amounting in all to £605,275. Dividends received from its holdings are slightly greater than in 1912, being £409,026, but the depreciation has been so great as to preclude the payment of a dividend by the corporation. Last year £255,000 was distributed. Moreover, the excess of liabilities over quick assets is £572,881. This, while not dangerous, suggests that the corporation over-extended itself at a time when untoward conditions were unexpected, and must now conserve its resources as against the calls falling due on its wide-spread commitments. In short, the position of the corporation reflects the general experience of financial enterprise in London, and elsewhere, during the last twelve months.

Juga.

This fiasco is of more than passing interest to the profession, and to the public. It concerns vital principles in practice and in business. The Juga (Nigeria) Tin & Power Company was registered four years ago to acquire certain mining rights in Nigeria from the Champion Tin Fields. In the recent report of the Juga Company, it is stated that the small production of tin, that is, the collapse of the enterprise, is due to (1) failure to discover the rich deposits reported by Messrs. C. G. Lush, L. H. L. Huddart, and A. W. Hooke, and (2) ill advised and extravagant management prior to June 30, 1913, when Mr. J. J. Hunter assumed the local management. In the report upon which the company was floated, it was estimated that 15,556 tons of black tin could be recovered on the particular areas acquired from the Champion Tin Fields. The yield to date has been only 256 tons, and it is estimated that the further amount recoverable is only 360 tons, making 616 tons as against the thousands assured in the 'particulars' in lieu of prospectus, advertised on March 17, 1910. The tin areas in question were acquired from the parent company for £100,000 in cash and 125,000 shares, out of 282,500 shares issued at £1, and quoted during 1912 at £1½. Three of the directors of the vendor company were also on the board of the subsidiary, namely, Sir Horace Regnart, Mr. Frank N. Best, and Mr. S. R. Bastard, the last being the first chairman of the Juga, as well as chairman of the parent company. All three have resigned. At the recent meeting, Mr. Best, then still a director, was present, and to him the chairman, Mr. Bright, in vain appealed to offer some explanation of his attitude in the matter. It appears that Sir Frank Crisp, as the authority on company law, was consulted with regard to the liability of the vendors, but advised that it was doubtful if damages were recoverable under civil law. The chairman also stated that he had repeatedly approached the vendors with a view to getting some redress, but without result. He concluded with an expression of hope "that the misfortunes of this company may hasten two greatly needed reforms ; one is the creation of some institution of mining engineers, which would vouch for the reliability of reports made upon mining properties and without whose certificate no mining proposition could be successfully floated ; the other is refusal on the part of the committee of the Stock Exchange of a special settlement in the shares of any company—no matter how influential its sponsors may be—which does not issue a prospectus." This part of Mr Bright's speech does not appear in the report appearing in the daily financial Press. We sympathize keenly with his feelings in the matter. It is that of most of the honest non-technical business men that find themselves involved in a fiasco of this kind. They are astonished at the absence of safeguards and the errors made by advisors assumed to be trustworthy. They find that the firm ground of supposed fact is a mere quicksand that engulfs all their fond hopes of a successful enterprise.

Reviewing this episode for the sake of the lessons it may teach, it seems to us, in the first place, that the interbreeding of companies and the flotation of subsidiaries lends itself readily to objectionable proceedings. It is difficult to act as a buyer and a seller at the same time; it is even more difficult to perform the duties of a trustee concurrently with performing the legerdemain of a promoter. The duplication of directorates eliminates a check on the doings of financial operators. Next, of course, the issuance of a statement in lieu of prospectus enables the promoter to evade the legal obligations imposed by the Companies Acts, under which such details as purchase price, promoter's profits, and underwriting commissions must be made public. Undoubtedly this evasion of the obligations implicit in a prospectus constitutes a gross scandal in Stock Exchange administration. Coming to the most unpleasant feature of the Juga episode, namely, the failure of the mining operations to confirm the estimates of the engineers, we have this to say, that none of the gentlemen mentioned is a member of the Institution of Mining and Metallurgy, although two are 'associates,' which is by no means the same thing as being 'members.' The qualifications for associateship are much less exacting than those for membership; indeed, they make no great demand either on age or experience. The Nigerian mining business has suffered, from a technical, not a share-dealing, point of view, on account of the employment of men of minor standing who have been paid small fees while their reports have been used by promoters for flotation purposes as if they were engineers of the highest rank that had been paid commensurate fees. Some of them were deficient in the experience of alluvial tin mining; most of them were young in experience of any kind. We can only say to Mr. Bright, and other earnest men like him, that no institution can vouch for the reliability of a report; that involves a financial guarantee, to be given by a commercial organization. A mining assurance company would be required to perform this function. Meanwhile, the publicity given by such a statement as he made at the Juga meeting is an effective means of awakening public interest in these difficult matters and serves as a possible deterrent to the perpetration of similar blunders and obliquities.

Reliability of Reports.

We commend the attention of the Institution of Mining and Metallurgy to the speech of Mr. Philip Bright, chairman at the recent meeting of the Juga (Nigeria) Tin and Power Co., Ltd. He spoke almost pathetically of the apparently incorrect estimates made by three engineers, two of whom were 'associates' of the Institution. As we suggest elsewhere, probably he did not realize that associateship and membership are distinct grades as regards professional status. We shall be interpreting the views of the profession, we believe, in suggesting that while the junior engineer is qualified for the supervision of operations and the erection of plant, it is to the seniors that directors and mine operators generally should look for advice on the appraisal of mines. That particular kind of work requires the ripened experience and matured sagacity that are likely to be conjoined only in the senior members of the profession. However, the point to which we wish to draw attention is the keen expression of regret by Mr. Bright that there is no institution that will "vouch for the reliability of the reports" of its members, an institution recognized by the public to such an extent that "without its certificate no mining proposition could be successfully financed." That may seem Utopian, but it need not be regarded as the heated mirage of a crestfallen director's imagination. We have an Institution, and it is an organization that is steadily gaining in prestige. To approximate Mr. Bright's ideal, it only needs a little more authority and a little more courage. The authority may come, as we hope it will, by the grant of a charter ; but the courage cannot be bestowed by royal prerogative or legislative act. In order to exert disciplinary powers, the council of such an Institution must be prepared, like the committee of the Stock Exchange to warn, censure, or expel any member according as he is guilty of minor delinquency, culpable carelessness, or indubitable fraud. And the correction, whether light or heavy, should be recorded in the bulletins of the Institution, as a deterrent to others and as an evidence to the public that some measure of protection is obtainable. At present any infractions of the professional code are met by correspondence, ending sometimes in the resignation of a member, for reasons interpreted variously by him and the officers of the society with which he has severed his connection. Such hole-and-corner proceedings have only a faintly salutary effect. To protect the public and to cleanse the business of mining in London, it is necessary that the Institution should exhibit the strength of its convictions and the courage of its ideas. The problem to which Mr. Bright drew forcible attention is a prickly one; it is one requiring a firm grasp; otherwise it will leave more sting than perfume.

Meanwhile, it is the duty of the engineers concerned, for themselves and for the sake of the profession, to come forward with explanations, if any there be, for such discrepancies as those attacked at the Juga meeting. Our columns are always available to members of the profession for this purpose, and we are never so happy as when this Magazine can prove of service in defending engineers when unavoidably entangled in the complications arising from misdirected finance.

Health on the Rand.

The report by Surgeon-General W. C. Gorgas on health conditions on the Rand marks him as a plain, straightforward, and modest man, disinclined to wrap his science in tantalizing verbiage. His language is simple, and even the most casual layman cannot fail to understand his views and recommendations. Those who know his work on the Panama Canal are aware that he has done wonders in reducing the ravages of disease, not only malaria, but pneumonia and other pulmonary complaints. Many people in this country and in Africa have laboured under the misapprehension that his success on the Isthmus was confined to the killing of mosquitoes, and they have expressed wonder that his services should be requisitioned on the Rand, where phthisis and pneumonia are the particular scourges. It is therefore desirable to record that his work in connection with pulmonary troubles and general hygiene on the Isthmus was of an importance equal to his investigations with regard to malaria, and that his knowledge as regards health conditions in large communities of coloured labour is unrivalled. The Transvaal Chamber of Mines showed a wise discretion in deciding to seek his advice, for his experience of ten years on the Isthmus was worth more to Johannesburg than the results of any new series of investigations made by a local authority. A visit to the Rand extending over two months and a half was sufficient for General Gorgas to secure a grasp of the present position as regards coloured labour, and to formulate recommendations that can be carried into effect cheaply and without any upheaval of racial manners or customs.

His report deals with pneumonia, tuberculosis, miner's phthisis, water-supply, disposal of excreta above and below ground, the choice of food, and hospital treatment. To epitomize, we may say at once that the chief fault he finds is that the housing accommodation does not err on the side of generosity. The sleeping quarters are over-crowded, and food is stored, cooked, and eaten in these cramped spaces. He shows that over-crowding not only reduces the stamina of the human being, but vastly increases the chances of conveying infection. With regard to pneumonia, experience indicates that this is a white man's disease, caused by the germ *pneumococcus*, which finds its opportunity of committing ravages when the system is suffering from depression, following cold, starvation, or severe illness. By long contact with the germ, the white man has gained a power of resistance to it, and the same immunity has been won gradually by the coloured races. It is the newly recruited native, brought from countries hitherto knowing little of the white man, that is the prey of the *pneumococcus*. The mortality among the Tropical natives two years ago was so terrible that the Government issued an order preventing their entry into the territory of the Union. At the time it was generally considered on the Rand that the cause of the mortality was the sudden change of climatic surroundings, and it is only recently that the true nature of the infectiousness of the disease among new natives has been appreciated. General Gorgas quotes his investigations into the causes of the spread of pneumonia on the Isthmus, detailing how he arrived at the conclusion with regard to the danger to the new native. His remedy is to reduce the chance of transmission of the *pneumococcus* from one subject to another, and by, as far as possible, keeping together a community consisting of seasoned natives. He discusses Sir Almoth Wright's recommendation for inoculation against the disease, and recommends further investigation along this line, though the results so far obtained in practice do not appear to have impressed him deeply. With regard to tuberculosis and miner's phthisis, his recommendations, other than those relating to dust-prevention, are based on much the same principles, that is, the reduction of the chances of contagion by preventive measures and by increase in the accommodation per capita. His remarks on food contain the suggestion, novel in Africa, that the native is too much of a vegetarian, and that the amount of nitrogenous food allowed is insufficient for the proper execution of hard manual labour. On the Isthmus, the best results were obtained when the men were accompanied by their wives and families, and when the food could be purchased at cost and cooked at their own homes according to their particular liking. Moreover the presence of their womenfolk made them content to remain and not wander from mine to mine, or from the mine to the old home. Briefly, General Gorgas recommends for the Rand the establishment of native communities where all the creature comforts can be obtained. Such settlements should be designed so as to prevent over-crowding. When these new married quarters are provided, the strain on the present buildings will be relieved, and the single men will be in the enjoyment of the desirable extended accommodation. General Gorgas is also emphatic on the necessity for providing the bachelor quarters with rooms for cooking and eating, so improving the amenities of the meals, and making the living and sleeping rooms cleaner and more comfortable. The first cost of these alterations would be trivial, compared with the million pounds spent every year on recruiting, and each company would be able to maintain its labour force and not made continually nervous by the fluctuating and uncertain supply of workers. There is no economic reason to be urged against the establishment of such communities, for in spite of the Rand having reached its zenith, an effective mining population will be required for thirty years. Moreover, the possession of a reliable and well trained labour force will substantially reduce the cost of operations, and render profitable many large areas of banket at present of doubtful value. Taking everything into consideration, we feel sure that the Chamber of Mines collectively and the controlling groups individually will accept General Gorgas' reasonable recommendations, not only for the benefit of the workers, but also from the standpoint of economical exploitation and public policy.

Participations.

A young engineer came to us recently to ask advice in regard to the acceptance of shares in the company employing him, a share bonus having been allotted to him by the board in recognition of excellent service on the staff. The incident was a compliment, which was properly appreciated, but he had an idea that it was undesirable for him to hold shares. We confirmed this belief, and urged him to thank his directors, but to decline the shares on the basis that his service would be as constant and his judgment safer if he kept himself entirely detached from the share-market. We are glad to see that such sane notions are making way among the younger engineers, and we look forward to the day when they will be appreciated by their employers. If the latter desire to reward or encourage the members of their engineering staff they will find it much cheaper in the long run to raise salaries or award cash bonuses rather than recompense their employees in paper that necessarily makes them participants in share speculation. Even the employer that speculates, if he be wise, will see to it that those on whom he depends for accurate information are wholly free from the fever that infects the votaries of the ticker and tape. In any case, we turn to the junior engineer as to a younger brother, and tell him that share-gambling has ruined more members of our profession than either *wein, weib*, or *gesang*. If a professional man is to possess his own soul and preserve his self-respect he is advised to keep clear of Throgmorton street, Wall street, Collins street, or any other locality that typifies share-dealing. A man's heart is where his treasure is; a man's interest follows his money; if a share speculation involves—as it usually does in the case of a youngster—as much as two or three years' salary, then he does his work with an eye on quotations, his routine work suffers, his judgment becomes clouded by an unhealthy optimism. Many is the clever technical graduate who began his career with promise only to step from the hard uphill grind into the *facilis descensus Averni* that leads from bucket-shop to bankruptcy. But why refuse the chance to make money quickly? says one. Where is a man to invest his savings except in the things—mines—concerning which he knows something? asks another. To this we reply that a considerable measure of observation warrants us in saying that the engineers who stick to their work, save half their salaries or fees, and invest them in bonds or debentures, will in the evening of life be richer and happier men than those who tried to find a quicker short-cut to affluence. What the profession should demand is not a participation in the game of speculation but increased payment for detachment from it. Directors and other employers will learn in time that those who are able to give undivided energies to their technical work, and those who do not expect to take a hand in the buying or selling of shares, are more efficient and more trustworthy because of their single-mindedness of purpose and unswerving loyalty. If directors are not alive to this fact, we hope the engineers in contact with them will explain these matters, so that in the end we may have an independent and unbeguiled mining profession in which directors, speculators, promoters, and public may unite in placing perfect confidence, within the limits of human imperfection.

PERSONAL

LAWRENCE ADDICKS has resigned as manager of the refinery at Chrome, New Jersey, belonging to the United States Metal Refining Company.

HENRY BRELICH has returned from Russia.

R. GILMAN BROWN is making a tour of inspection to the Kyshtim, Tanalyk, and Ridder mines, in Siberia.

THOMAS BUTEMENT, of the School of Mines of Western Australia, has returned to Kalgoorlie.

FREDERICK CLOSE is on his way to Juneau, Alaska.

J. H. CURLE, on his return from Abyssinia, has gone to Nicaragua.

NELSON DICKERMAN, manager for the Pato company, Colombia, is in London.

J. HOWARD EVANS is on his way to South Wales to install basic converters at the Cape Copper works.

ROWLAND C. FEILDING has returned from Spain.

NORMAN R. FISHER is here from Cobalt.

DONALD F. FOSTER has returned from West Africa.

PHILIP L. FOSTER, representative of the Exploration Company in America, has moved his office to 62 Broadway, New York.

JAMES GARLAND, metallurgist to the Namaqua Copper Co., is on holiday in England.

GEORGE H. GARREY, until recently the chief geologist to the American Smelting & Refining Co., has commenced independent practice as consulting mining geologist at 115 Broadway, New York.

DONALD GILL has left for Russia.

W. M. GIMSON, manager for the Compañia Española de Aceites de Esquisto, at Ribesalbes, in Spain, has resigned, and is returning to London.

B. C. GULLACHSEN has left the Rand and is now in London.

R. T. HANCOCK is here from Nigeria.

E. E. HARDACH, manager of the Witwatersrand Deep, passed through London for Nevada.

C. S. HERZIG is expected from Norway.

EDWARD HOOPER has recovered health after a holiday in Italy.

ALFRED JAMES sailed on May 9 on his way to Cobalt.

HERMAN A. KELLER is due from New York.

MARK R. LAMB passed through London on his way from Chile to Milwaukee.

G. F. LAYCOCK has gone to Atbasar.

GEORGE A. LAIRD, who was for a short time in charge of the concentrator at Great Cobar, now idle, has opened an office as consulting engineer at Sydney.

STEPHEN J. LETT has left for Russia.

FRANK LORING underwent an operation during April, and is now convalescent.

A. K. MACFARLANE is here from Chihuahua, Mexico.

WILLIAM C. MADGE has gone to the Ridder mine, in the Altai.

JOHN C. MANCE has gone to India.

JOHN MORGAN has resigned as manager of the South Kalgurli mine owing to ill health.

ARTHUR L. PEARSE sailed for New York by the *Campania* on April 23.

WALTER G. PERKINS has left for the Messina copper mine in the Transvaal.

H. POMEROY, JR., is on his way home from Chile.

C. W. PURINGTON has been appointed consulting engineer to the Lenskoie Gold Mining Company, of St. Petersburg, and technical advisor to the Lena Goldfields.

MARK L. REQUA, of San Francisco, was in London.

C. H. RICHARDS, manager of the Nundydroog, has returned to India.

T. A. RICKARD sailed for New York on May 13.

P. A. ROBBINS, manager of the Hollinger mine, Ontario, is taking a holiday in Europe.

CHARLES M. ROLKER has moved his office to 59a London Wall.

J. H. RONALDSON has gone to Sumatra.

FRANK STILLWELL has been appointed lecturer on geology in the Adelaide University.

NORMAN STINES, manager of the Sissert Estate, has been in London.

LESTER W. STRAUSS is now resident at Valparaiso.

OTTO SUSSMAN has moved his office to 61 Broadway, New York.

J. E. VAUGHAN, Government Inspector of Mines for the Union of South Africa, is here from Johannesburg.

E. A. WALLERS has been elected president of the Transvaal Chamber of Mines.

D'ARCY WEATHERBE has returned from Ontario.

JAMES WHITEHOUSE, manager of the Village Deep, is on holiday in London.

POPE YEATMAN has returned to New York from Chile and has gone to Nevada.

RUSSELL B. WOAKES is home from Nundydroog for a holiday.

SPECIAL CORRESPONDENCE

CALCUTTA.

Dalbhum.—This is the name of a company formed in Calcutta last July with the object of acquiring and prospecting mineral leases in Dalbhum, a district on the Bengal Nagpur Railway, 200 miles from Calcutta. The prospecting proved satisfactory, and the analyses obtained from samples taken from the various lodes warranted the property being opened up on a large scale. There is now about 7000 tons of ore in the development dumps awaiting treatment. The company has ordered a Nissen stamp-mill, which should be at work on the property in the course of the next few months. The 500-rupee shares in the syndicate are now worth 5000 rupees.

Tavoy.—The wolfram deposits in this district of Burma are being opened, and in many cases the results are most gratifying. The Rangoon Mining Co. has installed a milling and concentrating plant and estimates the production at about 60 tons of concentrate per month. The Hpaungdaw concessions are still being worked without any machinery. All the ore is treated by hand in a crude manner, and owing to this method of working at least 5% of the concentrate is being lost, or passing into the dumps. The production for some months past has been 20 tons of concentrate assaying 72% WO_3. Statistics show that the output of wolfram from Tavoy district has doubled in the last twelve months.

Bengal Coal.—The market is generally good. Although the shortage of wagons severely hampers the handling of the coal, any new property proved to contain one of the first-class seams is readily taken up. The firm of Turnbulls (Glasgow), Limited, has taken up Damaghooriah, a property of 550 bigghas in the Raneegunge district, lying between Ramnuggar and the Lal Bazaar collieries belonging to the New Beerbhoom Coal Co. There are numerous excellent seams, some of which outcrop on the property. At a depth of between two and three hundred feet it is assumed that the famous Lackdeeh seam will be cut. This seam is from 90 to 100 ft. thick. A large proportion is first-class and the remainder a good second-class coal. Turnbulls are making arrangements for boring and testing the property with a diamond-drill.

VANCOUVER.

The mineral production of British Columbia in 1913, according to official figures, was worth rather more than $30,000,000. Of this total, $17,700,000 represented metals in the following approximate proportions: Gold, $6,140,000 (placer $510,000 and lode $5,630,000); silver, $1,970,000; lead, $2,170,000; copper, $7,100,000; zinc, $320,000. By far the greater part of the lode gold, the copper, and probably one-fifth of the silver, were the product of the mines of five companies, the Consolidated Mining and Smelting Company of Canada; Granby Consolidated; British Columbia Copper Co.; Hedley Gold Mining Co.; and Britannia Mining and Smelting Co. The information that follows relates to these five companies; some particulars of other companies operating in British Columbia will be supplied later.

Consolidated Mining and Smelting.—During thirteen weeks of the current year, to April 2, the quantity of ore received at the Consolidated Mining and Smelting company's smelting works at Trail was 92,140 tons, of which 70,662 tons was from the company's own mines and 21,478 tons was custom ore, the latter including 5596 tons of ore from mines in the adjoining state of Washington. Of the ore from the company's own mines, 4609 tons was from East Kootenay, 3361 tons from Ainsworth, 283 tons from Slocan, 4878 tons from near Nelson (nearly all from the Silver King, which years ago was owned and operated by the Hall Mining and Smelting Co., with head office in London), and 57,531 tons from Rossland mines, including 17,342 tons from the Le Roi mine. With the exception of East Kootenay, which shows a decrease of more than 5000 tons, there was an increase in quantity as compared with the corresponding period of 1913, from each of the districts mentioned. It is satisfactory to note that the outlook is favourable to the maintenance of the increase, and that the decrease in the output from the company's Sullivan group of mines in East Kootenay was not occasioned by shortage of ore, for the ore reserves continue to be large, but by conditions that made it advantageous to obtain more ore from other mines during the winter months. The company's mines in Ainsworth district, and the Silver King group near Nelson, may be regarded as producers in steadily increasing degree, and as contributors of profit now that they have again been brought to a stage of regularly making an output. It is known, too, that the ore reserves in the company's Rossland mines are large and the ore in the War Eagle-Centre Star group of an average content that will leave a good margin of profit above cost of mining and smelting.

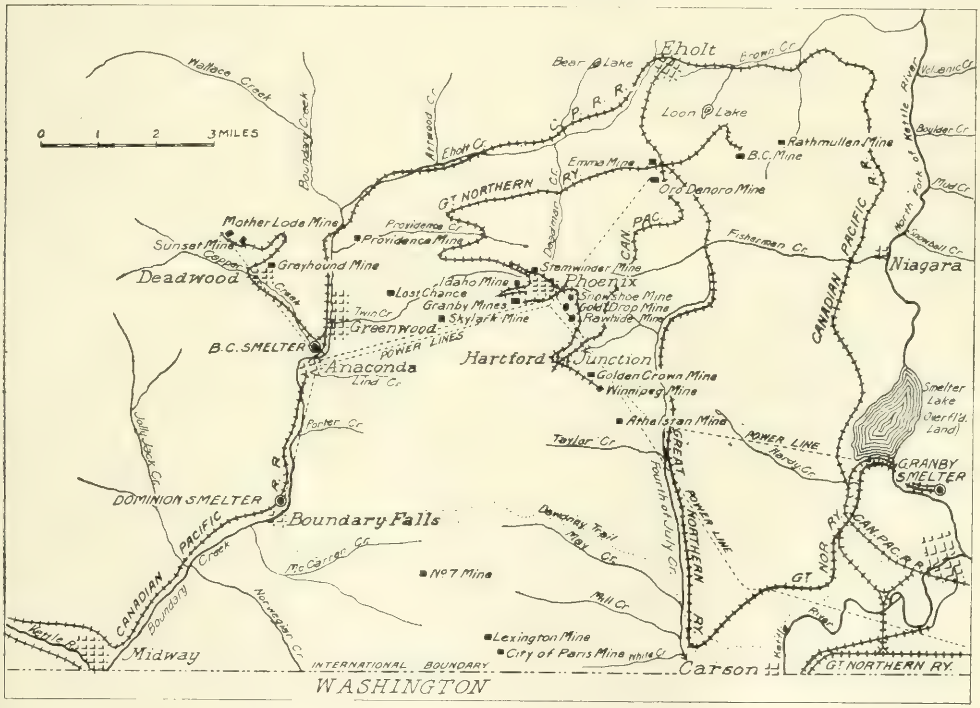
At the company's reduction works at Trail, in both the smelting and refining departments, conditions are generally satisfactory. Gradually smelting costs are being lowered by the substitution of modern smelting appliances and by the introduction of more labour-saving machinery. This applies to the handling and smelting both lead and copper ores, in both the sampling and blast-furnace departments, especially the latter, where larger modern furnaces are taking the places of those of older and less economical design.

Financially, the company's position has been improved. A change from June 30 to September 30 as the close of the year made the accounts to the close of the last financial period cover fifteen months instead of twelve. The net profit for that longer period was \$998,367 as compared with \$310,345 for the year ended June 30, 1912. Payment of dividends was resumed, after several years without a distribution of profit having been made, in October 1912, and during the period to September 30, 1913, there was a total dividend disbursement of \$464,352, which was at the rate of 8% per annum on the issued capital of \$5,805,000. Since then two 2% dividends have been paid, one early in January and the other in April, together \$232,176. Shareholders have been asking for an increase to 10% per annum, but the directors have not yet acceded to their request.

The Granby Consolidated company which has for years been operating copper mines and smelting works in Boundary district, during the last three years has been also developing a copper property known as the Hidden Creek mines, situated near Alice arm, Observatory inlet, Skeena mining division The purchase of this property, development and equipment of the mines, construction and equipment of a hydro-electric power system and a 2000-ton smelting works, and buildings, transportation facilities, shipping dock, etc., have together involved an outlay of fully \$3,000,000. The new smelter is now in operation, the first furnace having been blown in on March 16. No information has yet been made public as to results, but it is known that the company's engineers estimate that there has been developed a total of approximately 9,000,000 tons of ore containing an average of 2·2% copper and 20 cents per ton in gold and silver. This new enterprise, it is expected, will improve the company's position as regards earnings, profits having been comparatively small during the last six months, the average metal recoveries from ores from the company's Boundary mines, at Phœnix, having fallen to about 17 lb. copper, 0·208 oz. silver, and 0·0326 oz. gold per ton. It is estimated that there is still more than 5,000,000 tons of ore remaining in the company's Phœnix mines, which means a known ample supply for the smelting works at Grand Forks for at least four years. The production figures for three months ended March 31 last show that there was recovered during that period from 300,093 tons of ore (293,160 tons from the company's own mines and 6933 tons of custom ore) 5,208,550 lb. copper. The following statement, published at Grand Forks and probably dependable, shows the need of a higher average price for copper or the larger metal recoveries expected from the Hidden Creek ore: "Granby Co. reports net earnings of \$167,861 for the three months ended January 31. This compares with a profit of \$253,808 for the quarter ended October 31. During the last nine months, therefore, it seems that the Granby Co. has failed to earn sufficient to meet its full dividend requirements of \$6 a share annually and the interest on its bonds. Its Hidden Creek operations, however, should soon double its current operating profits." During its last financial year the Granby company's net profits were \$1,214,599, out of which were paid dividends totalling \$449,955 and discount interest and expenses in connection with issue of bonds, \$80,665.

The British Columbia Copper company, which sixteen years ago commenced copper mining in Boundary district and in 1900 established smelting works at Greenwood, has during recent years been gradually extending its operations, purchasing more mining properties and developing some others under option of purchase, in these ways using the greater part of the profit derived from its mining and smelting operations in Boundary district. At length it was found imperatively necessary to make financial provision for continuing operations over the wider field entered several years ago, so it was decided, subject to the support by holders of a majority of the shares in the company, to organize a new company to be known as the Canada Copper Corporation, Ltd., to have an authorized capital of $5,000,000 in 1,000,000 shares at $5 par value, and to be empowered to issue $1,000,000 in ten-year 6% convertible debentures to be dated April 1, 1914, and to be convertible at any time on or before maturity into shares of the new company at par on the proposed basis of capitalization. The debentures are to be at call by the Canada Copper Corporation at any time after three years from their date, on 90 days notice, at 10% premium and accrued interest. British Columbia Copper company's shareholders have been offered the right to exchange their shares for those of the new corporation, share for share, conditionally that they subscribe and pay at par for the convertible debentures to the extent of $1 for each of the old shares so exchanged. The British Columbia Copper Co. has an authorized capital of $3,000,000 in $5 shares of which there are outstanding 591,709. The organization of the new corporation was to be conditional upon at least 51% of the shares in the old company being deposited for exchange, and as 315,000 shares had been so deposited before the end of March, the plan of the directors for financing the new company will be completed.

The company's most important new operations have been during the last three years at Copper mountain, Similkameen, where approximately $550,000 has been expended in acquiring and developing copper-bearing claims having a combined area of about 1250 acres, partly owned in fee and partly under option of purchase. At times more than 100 men have been employed on these properties and five diamond-drills have been used. The chief result has been the development of "reasonably assured and probable" ore in excess of 4,000,000 tons containing an average of 1·87% copper and from 25 to 50 cents per ton in gold and silver. Much of this ore will be concentrated at a mill to be built in the vicinity of Copper mountain, a mill site and water rights



THE BOUNDARY DISTRICT, BRITISH COLUMBIA.

having been secured, and the concentrate sent to Greenwood for smelting with ores from mines in Boundary district.

The company has for some time past been working the Mother Lode mine near Greenwood, the Rawhide mine near Phœnix, several smaller mines in Boundary district, the Lone Star & Washington mine, just south of the international boundary line eight miles from the smelter, the Napoleon mine, also in the state of Washington, and three small mines in West Kootenay—two copper properties near Nelson and one low-grade gold property near Slocan lake—but only one of these three has yet made a considerable output of ore.

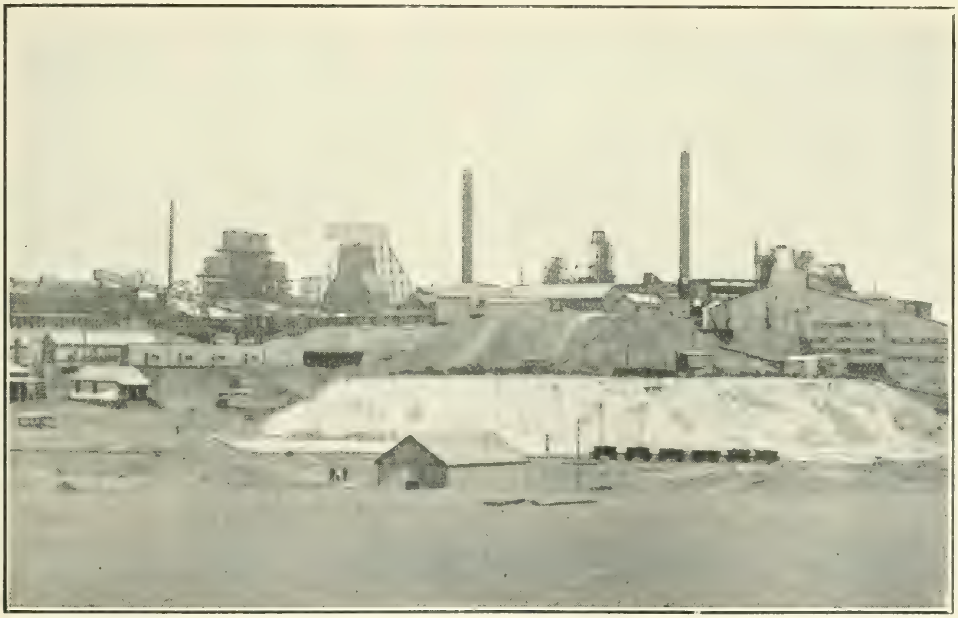
During its last financial year, ended December 31, 1913, the company smelted at Greenwood 353,422 tons of ore from its own mines, 259,485 tons of custom ore (chiefly from the Rawhide mine of the New Dominion Copper Co., controlled by the B.C. Copper Co.), and 8303 tons of converter slag, etc. There was produced 8,377,655 lb. of blister copper containing 26,641 oz. of gold (chiefly from purchased gold ores), 137,052 oz. silver, and 8,296,902 lb. fine copper. The average yield of metals from ores from the company's own mines was: Copper 12·175 lb., and gold and silver $0·5734 per ton. The total cost per ton was $2·8108 as compared with $2·4596 per ton in 1912.

The Hedley Gold Mining company, which owns the Nickel Plate-Sunnyside group of gold mines in Camp Hedley, Similkameen, is erecting a hydro-electric power-generating plant on Similkameen river, near Hedley, and for this work the directors have appropriated $200,000. The company has made its customary quarterly distribution of profit, amounting to $60,000, being 5% for the quarter ended March 31 on its $1,200,000 of issued stock. The recently published annual report for 1913 shows that 70,796 tons of ore was crushed, this having an average assay-value of $12·03 per ton. The total value of the gold recovered was $802,330 and the expenditure $397,075; the net profit, including $7402 interest, was $405,254. The company distributed during last year a total of $360,000, or 30% on its issued capital. The undivided profit, after payment of dividends, was $272,096. The reserve tonnage of ore in the company's mines is estimated at 413,000 tons, and the average assay-value of $10 per ton compares with $12, the average of the past years.

The Britannia Mining and Smelting company which last year made the second largest production of copper of all the companies operating in British Columbia, with an output of approximately 13,100,000 lb. copper and 73,000 oz. silver from 213,500 tons of ore, is continuing its preparations for considerably increasing its production. The company owns a large group of claims on Britannia mountain and neighbourhood, near Howe sound. Britannia Beach, where the concentrating mill, power-plant, shipping dock, and office headquarters in the province are situated, is 28 miles by water from Vancouver City. The old mine-workings have their outlets at an elevation of from 3275 to 3775 ft. above Britannia Beach, with which there is connection for transportation purposes by an aerial tramway about 3¼ miles in length. The lowest level of the old workings is 1000 ft. below the outcrop of the ore. In order to overcome the disadvantages attendant upon having the mining camp at so comparatively high an altitude, a new camp has been established at what is known as the Half-way, and a cross-cut adit has been driven 4350 ft. into the mountain. From this new low level two rises are being cut to the old 1000-ft. level, which is 1200 ft. above. One of these is an exploratory working; the other is intended for use, when completed, as a three-compartment main shaft, with two hoisting compartments each 6 ft. by 7 ft. 6 in. clear and a manway 3 ft. by 7 ft. 6 in. This shaft is being timbered with 12 by 12 in. Douglas fir (the best timber obtainable on the Pacific coast). At 200 ft. up, a station has been cut, and here a large crusher will be used for reducing the size of the ore before it is dropped to the loading bins over the railway tracks in the adit underneath. From the face of the adit to the top of an incline above the concentrating mill, the distance is about five miles by a switchback railway on which two 15-ton electric locomotives driven in tandem will haul ore-cars having a capacity of 20 tons each. The incline from 1000-ton storage bins at the end of the railway is 5500 ft. long down to ore-bins above the concentrating mill; it is double-tracked with 60 lb. steel rails, and two 16 ton skips will be operated over it. A double-drum engine will allow of either track being used if for any reason the other track be not workable. A Minerals Separation flotation plant, having a capacity of 400 to 600 tons per day, has been in successful operation for some time. The average recovery of copper is stated to be about 95%. The concentrate shipped to the smelter runs 16 to 17% copper, and contains about 15% excess iron, as against a silicious product previously made.

MELBOURNE.

John Darling.—This mail takes with it to England the news of the death of John Darling, chairman of directors of the Broken Hill Proprietary company. The deceased was a man of wonderful force of character and exceptional enterprise. By the exercise of these qualities he acquired great wealth at a comparatively early age in the exciting arena of the wheat market. Like so many Australians, he put much money into mining. He was for long one of the directors of the Great Boulder Proprietary and an active supporter of North Queensland tin-mining. At Broken Hill he also had large interests, and at the time of his death was by far the largest holder of shares in the Broken Hill Proprietary, of which he had acted as chairman since 1907. Mr. Darling's last financial action in connection with that company was to join with a friend in Adelaide in underwriting 100,000 shares in the recent issue of that company made to secure capital for the erection of iron and steel works at Newcastle, in New South Wales. Up to the time of his death, he was prominent in connection with the negotiations for the proposed sale of the company's smelting plant at Port Pirie. In all his connection with the great company to which he was so attached, Mr. Darling brought only one thought: that was to serve the shareholders, not to bother about the market. His belief in the future of the iron and steel trade of Australia had much to do with the decision of his board to turn to account the huge deposit of iron ore belonging to the company in South Australia, known as the Iron Knob, for he carried into the board-room all the strength and confidence in the project that he invested in the daily life of his own huge business. Mr. Darling at one time engaged actively in politics, but he retired some years ago, and though urged again and again to enter public life in the Federal Parliament, he refused. Had he done so, it would surely not have been long before he became one of the great leaders of the Liberal cause in the Commonwealth.



BROKEN HILL PROPRIETARY MINE.

Port Pirie.—In discussing the death of Mr. Darling it is easy to pass to a criticism of the scheme by which the North Broken Hill and the South Broken Hill companies are to acquire, in some way or other, the smelting interests of the Broken Hill Proprietary at Port Pirie. The phrase "in some way or other" is used advisedly, for no one knows except the chosen of the inside circle what structure the engineers propose to raise. A new company is mentioned. Whence the capital is to come is not clear, though no doubt in due course some of the details will be disclosed. As things stand today, the only announcement is that the scheme is in hand, and that later other companies may join the North and the South in the venture. An absurd amount of mystery has been invested in the transaction. In Adelaide, for instance, it was announced that word had "come from London" that a deal was on. In Melbourne no circumlocution of the kind was attempted, though some of the directors openly avowed, poor things, that they had not been let into the know. And yet they retain their seats on the boards! What a testimony to the strength achieved by the group that of late years has acquired a domination over the affairs of several of the great mines of Broken Hill. The way in which the scheme has to be viewed is that if the Proprietary company can get a fair price for the works, it is well quit of them. For some time past the other Barrier companies have let contracts for the sale of lead concentrate over the heads of the Proprietary. So the company has had to depend on its own output and on the outputs of the smaller mines for smelting material for Port Pirie. Some of the leading ore-buyers aver that it would have paid the Proprietary to close its works at Port Pirie and to sell its raw products. The question was brought to a head, so far as the proposed purchase went, by the metal-buyers here raising the returning charges to over £5 per ton. This move on the part of the little coterie of German operators is supposed to have led the directors of the South and North companies to contemplate the possibility of treating their own ores. Naturally their thoughts flew, despite old personal antipathies, to the Port Pirie works. Now, to onlookers it has occurred that there may be more in the deal than meets the eye. Seeing the part the Broken Hill lead production plays in the markets of the world, it may be that the real scheme is to secure the control of the lead output of that district in a few hands, and so to use it as a power in the metal markets of the world. If so, the project assumes a fresh potentiality. Still it is not one that can be dismissed, considering the close connection that exists between some of the leaders of the financial group that associates itself with Broken Hill and certain powerful people in the metal trade. All this is written before it is known how affairs are crystallizing, but they are considerations that occur to those who follow the little games of high finance as played with mines and stocks in the market-place.

Mount Elliott. — Another far-reaching scheme is that of Mr. W. H. Corbould for linking the Mount Elliott company with other mining interests in North Queensland. In every way the idea is commendable. But can it be carried through? The Mount Elliott has little rich ore left, and it has to come down to the treatment of a 3% material. But it has a smelter, and mines like the Mount Oxide, the Oxide Creek, and the Mount Cuthbert have none, nor have the Queensland Freehold or the Dobbin, near Mount Cuthbert. There is also a large outside region round Cloncurry that could be served by a central plant worked on the lines of the American plants. Therefore the idea of Mr. Corbould, for economic reasons, has everything to commend it. No argument exists why half-a-dozen little plants should be erected when one large one could do the work for all. But local jealousy and the interests of officials is sure to block the project until dire necessity drives them into the fold. The possession of capital is the strong point in the Mount Elliott armour, just as Mr. Corbould's capacity is of aid to his company. It is said that French engineers are to visit Australia to approve of the proposal; and they will be welcome. If they could only include the Hampden group in the general scheme the project would be all the better.

Malay Tin.—London appears to be interesting itself in some of the Malay tin-dredging companies that have been promoted in Australia. The latest venture to attract attention is the Deebook, situated close to the Renong Dredging company's property; it was floated in Melbourne on terms which, to Australian ideas, seemed to involve a very fair return to the vendors and the promoters. The bores averaged one per 5 acres, and it is asserted that these yielded results equal to nearly 2 lb. black tin per cubic yard of drift, while in 45 acres near the dredge site the average was over 3 lb. per cubic yard. Of course, if these results are verified by actual work, the Deebook has a fine future ahead. Other Australian-owned properties being exploited are not yet equipped with dredges, but it is expected that several large plants will be in full swing by the end of this year. If these are successful, a large amount of Australian capital is sure to flow to the East in search of other areas, as dredging is a highly attractive form of investment here.

Flotation.—It is reported that the long experimental work at the Mount Lyell mine to test the flotation process for the treatment of its low-grade ores has ended in success. The same thing also is said of the highly silicious ores at Mount Morgan. All this is due to the work done at Broken Hill, with Lyster in the van of the experimentalists. At Wallaroo, also, the flotation process has worked so satisfactorily that the company is installing further plant; and at Great Fitzroy, where the process was in use on a low-grade silicious copper-gold ore, recoveries have been up to the expectations of the company, though the fall in the price of copper has prevented profits being earned. All this work is of immense importance as demonstrating the extension of the flotation process to the treatment of low-grade copper ores. It must not be imagined that all that has to be done is to install a plant on any mine. The characteristics of the different deposits have to be determined, and then the application of the method has to be studied with the greatest care. The most important job of this kind being undertaken in Australia just now is the investigation being conducted by Bewick, Moreing & Co. into the deposit on the Tasmanian Copper company's leases, near Rosebery, Tasmania. The deposit contains complex zinc-lead sulphides carrying also a small percentage of copper with fair silver and gold contents. To treat it, the Horwood system of roasting is likely to be applied in conjunction with the flotation process. There is talk also of something of the same kind being attempted at the Hercules mine, about five miles from the Tasmanian Copper company's mine. This claim was introduced in London some time back, with the object of securing capital for the treatment of the ore by the Oker process, which also was to be used to extract the zinc from the zinc-bearing slags of the smelting works at Zeehan. That scheme fell through, so now the flotation process walks on the stage.

Queensland Minerals.—Figures relating to the mineral production of Queensland have been made public. These show that the value of the output for 1913 was £3,857,881, or a decrease of £317,474 as compared with the total for 1912. The gold output of the State shows a further decline owing in the main to the exhaustion of mines at Charters Towers and Gympie, and to the smaller production from Mount Morgan. In point of fact, the yield of copper is now of more importance to the State than that of gold. Unfortunately the closing of the Cloncurry smelters and the exhaustion of the rich ores of the Mount Elliott mine will not be compensated by the opening of other mines in North Queensland. The whole attitude of Labour is adverse to the handling of the low-grade deposits, because these cannot, with the metal at £65, stand a high working charge. The official figures of the output of the State for the past two years are as follows:

	1912		1913	
	Quantity. Oz.	Value. £	Quantity. Oz.	Value. £
Gold	347,945	1,477,979	265,735	1,128,768
Silver	569,181	66,188	604,979	68,438
	Tons.	£	Tons.	£
Copper	23,120	1,698,280	23,655	1,660,178
Coal	902,166	338,264	1,637,944	403,767
Tin	3,230	364,503	3,197	343,669
Lead	3,108	55,667	3,603	65,683

TORONTO.

Porcupine.—The statement of the results at the Dome for March shows 14,970 tons milled with a gold production of $87,657, which falls considerably short of the forecast. The final figures for the financial year ended March 31 show 101,812 tons treated, and a gold recovery of $1,043,995, the average per ton being $10·25. As compared with the previous year there was an increase of 44% in the tonnage milled and 13% in the gold production, while the average yield per ton milled decreased by $1·96. During the year, indebtedness to the amount of $230,138 had been liquidated. The Hollinger has cut its main vein at the 550-ft. level, where it is 10 ft. wide of average grade. Work on the enlargement of the mill from 40 to 60 stamps is proceeding, and the additional stamps are expected to be in operation early in August, giving the whole battery a crushing capacity of 700 tons per day. The foundations have been laid for the new power-plant at Gillies lake, which will be the largest in Northern Ontario and will furnish additional power for the Hollinger, the Acme, and other mines. It is being installed by the Canadian Mining & Finance Co., which has a controlling interest in the Hollinger. The agreement under which the McKinley-Darragh, of Cobalt, is to finance the Jupiter mine in return for an option on a half-interest having been duly ratified by the shareholders of both companies, the McKinley-Darragh has taken possession, and the mine is being unwatered. The winze sunk on the main vein from the 300-ft. level, now down 100 ft., will be extended 100 ft. deeper. The Foley-O'Brien mine has passed into the control of the Homestake Mines & Finance Co., with Charles L. Sherrill, of Buffalo, as managing director. The same company has purchased the Porcupine Little Pet and Fogg-Woodbridge claims situated south of the Dome. A plant is being installed, and active development will be undertaken. The McIntyre has reduced the par value of its shares from $5 to $1, and has now

3,000,000 shares at the latter figure. The mine has 200 ft. of ore, 6 ft. wide, carrying $23 per ton at the 400-ft. level. The mill is treating 125 tons per day. During March 4325 tons was milled, averaging $12·68 per ton, with a recovery of 97·8%. At the Dome Lake a good strike has been made in the drift on No. 3 vein, which shows a width of 4 ft. of ore. An electrical equipment is being installed.

Kirkland Lake.—The Teck-Hughes has developed 120 ft. of high-grade ore about 3 ft. wide averaging $42 per ton. The gold content is variable, in places being as high as $200 and $300 per ton. Work is proceeding slowly with a small compressor until electric power can be obtained. Harry Cecil and other members of a British syndicate recently inspected the property with a view to obtaining another option. Unless unforeseen difficulties occur, the Kirkland Lake mines will have electric power by May 1, as satisfactory progress is being made with the transmission line. At the Tough-Oakes all the necessary machinery is in readiness. The purchase of the Burnside claims, three in number, adjoining the Tough-Oakes, by the Kirkland Lake Proprietary, has been completed by the payment of the balance due on the purchase money, amounting to about $200,000.

Swastika.—The Swastika Mining Co. is being wound up under an order of court. This mine was in operation on a small scale before the Porcupine goldfield was discovered. During the boom that followed, the nominal capital was increased from $500,000 to $3,000,000, an expensive plant was installed, and development undertaken on a large scale. The veins, however, were found too narrow and scattered for profitable working, and the mine has been closed-down for some months. The seizure of the equipment by the sheriff to satisfy claims for wages resulted in liquidation proceedings.

Cobalt.—The annual report of the Nipissing gives the production of silver for 1913 as 4,552,173 oz., costing 24·09 c. per oz., as compared with an output of 4,688,000 oz. in 1912 at a cost of 17·39 c. per oz. The net profit was $1,660,271, and dividends amounting to $1,800,000 were paid. The ore reserves were estimated to contain 9,510,000 oz. silver. The general manager, R. B. Watson, pointed out that the company had entered on the second stage of its career, as before 1913 practically all the receipts came from high-grade ore, the milling ore being thrown on the dump. The high-grade ore is not only less in quantity than formerly, but production is limited by the capacity of the low-grade mill, which must handle all ore that goes through the picking-plant. While mining the wide rich veins near the surface, the company was enabled to turn out a large production at small cost, but, as greater depth is attained, the veins generally split up into stringers, which results in wider stopes and a lower average grade. The surplus at the close of the year was $1,259,060. The Kerr Lake company has started for the season the work of emptying Kerr lake, which is expected to be completed in June. The sides of the lake will then be cleared of mud by hydraulicking to allow of prospecting. The Beaver, having installed its new hoist capable of lifting from a depth of 1500 ft., is preparing to sink below the 800-ft. level. The Cobalt Lake has sunk a winze 60 ft. from the 225-ft. level on one of its main veins from No. 6 shaft. Three inches of 2000 oz. ore are in evidence at the bottom of the winze, which will be continued until the Keewatin formation is penetrated. The Cochrane has struck a rich vein at the 300-ft. level, and is extracting ore, having made arrangements to mill between 15 and 20 tons daily at the Timiskaming concentrator. The Gould has picked up on the 280-ft. level a vein found at 200 ft. yielding high-grade ore. Special general meetings held in Toronto of the shareholders of Cobalt Town Site Mining Co., Cobalt Lake Mining Co., and City of Cobalt Mining Co., ratified the merger scheme previously approved by the English holding companies. The properties represented will consequently be transferred to the new operating company recently incorporated under the name of the Mining Corporation of Canada, Ltd. The McKinley-Darragh has staked from four to seven acres of land forming part of the southern end of Cart lake, which has been uncovered owing to the partial draining of the lake. This area has been claimed by the Peterson Lake, but was shown as open ground on the official maps. It has never been prospected, but is known to be conglomerate, and may be valuable. Figures compiled by the mining engineer of the Timiskaming & Northern Ontario Railway Commission give the total tonnage of ore concentrated at Cobalt during 1913 as 664,845 tons, compared with 455,517 tons in 1912. Of this amount the cyanide plants treating low-grade ore furnished 133,297 tons, and water-concentration mills 531,548 tons.

Diamonds.—The occurrence of diamonds in Ontario has been proved by the Provincial

Bureau of Mines, though whether the discovery is of any economic value is doubtful. Samples of a chromiferous mineral found in Reaume township, about 20 miles north of Porcupine, were forwarded to R. A. Johnston, of the Geological Survey, for examination. Mr. Johnston reports that numerous minute diamonds occur in it. The rock in which the chrome mineral was found is peridotite, and is of widespread occurrence in the neighbourhood of Porcupine, and has also been found to contain platinum.

KIRKLAND LAKE AND TECK-HUGHES MINE.

JOHANNESBURG.

The amalgamation of the mines of the Rand is no new idea, although it has never until today been seriously and publicly advocated by a responsible official. Now we have Mr. George Nathan of the General Mining & Finance strenuously upholding, and Mr. R. W. Schumacher of the Rand Mines-Central Investment gently deprecating the advisability of such a bold step. Theoretically, a wholesale merging of interests is quite an attractive development, and there is little doubt that things will trend more and more in that direction as the mines become fewer, deeper, and poorer, and as the day approaches when the margin of profit diminishes and the closest economy becomes imperative. From the evidence led by these gentlemen before the Dominions Royal Commission and from a consideration of the general aspect of the problem the following advantages appear to hold good: the investor would have better security as a shareholder in one great mining concern than as a shareholder in a comparatively small unit where fluctuations and disappointments were more likely to occur. In times of labour-shortage work could be concentrated on mines where it would give the greatest return. The duplication of directors and staffs would be avoided. The monstrous expenditure involved by the present recruiting system would be largely saved. Workmen would have steadier employment, more regular wages, better health and living conditions. The shareholder and the State would benefit by the increase of profits due to concentration of effort. Against these advantages may be placed the following: Danger of social upheaval owing to the closing down of the poorer mines. A powerful gold trust would be created which, as American experience shows, would be a danger to clean government. Employees discharged from one mine would *ipso facto* be discharged from all, and would in consequence have to try some other occupation or leave the country. The power of those at the head and of their subordinates would lead to gross favouritism and to corruption of all sorts. There would result from complete centralization a rigid binding down by red tape, to the destruction of all individuality and elasticity. Solidarity of capitalistic control would engender solidarity of labour opposition. As amalgamations have already shown, economies prophesied are rarely converted into economies wrought. This amalgamation idea is by no means so visionary as some of its critics would have us believe; and the day may come when it will prove the only way of salvation.

The Transvaal Chamber of Mines annual meeting to review the mining history of 1913 was not productive of any remarkable pronouncement. Mr. John Munro, the president, covered the ground in an interesting way and from his remarks the following summary has been compiled: Of the total gold produced 23·01% reached the pockets of shareholders as against 21·39% in 1912. The coal sold showed an increase from 4,751,850 tons in the previous year to 5,225,036. The quantity of diamonds produced increased slightly and the value of the product greatly. Copper increased from £52,413 to £139,604 and tin production marked an advance. Underground work improved in efficiency and transport methods received special attention. Payment by results having proved successful in the case of hammer-boys, it has been extended to include machine-boys. Water-fed hammer-drills did good work in stoping and their employment is being extended with beneficial results. The various improvements effected bring an all-round reduction of mining costs within measurable distance. The native mortality rate fell from 28·83 per 1000 per annum to 26·61, but is still too high. In December 1912 the number of employees working on the Witwatersrand gold mines was 23,416 white and 193,974 coloured, a ratio of 1 to 8·28, and in December 1913 21,875 and 151,538, a ratio of 1 to 6·92. The increase in the proportion of white to coloured at the latter date was due to the philanthropic action of the mines in providing work for a larger number of white workers than the coloured labour position warranted. The Economic Commission established the fact that the wages paid on the mines of the Rand are such as to render workmen better off than workmen in any other part of the world, even when full allowance is made for the cost of living. The Commission recommended the abandonment of the flat contract system in favour of day's pay or day's pay plus bonus, and the removal of the barriers placed in the way of coloured labour. These barriers are created by the Government Mining Regulations and the Chamber has consistently maintained that they are unreasonable and probably ultra vires. Awards of compensation under the Miners' Phthisis Act for the 18 months ended January 31, 1914, amounted to the huge total of £1,098,136, of which £100,000 was contributed by the Government. These awards have been equivalent to an average of 7d. per ton milled during that period. To employ Europeans instead of natives at unskilled mining work, two of the former being taken as equal to three of the latter, it would not without increasing working cost be possible to pay such Europeans more than 4s. 9d. per shift, which is not a living wage. At rates of pay for European unskilled labour of from 7s. 6d. to 15s. per shift many mines would cease to make a profit and have to close-down. From the foregoing summary it is comforting to note that the noisy dust-raising monstrosity known as the reciprocating drill is gliding into disfavour, and that the vicious flat contract system will share its retirement. The payment of natives by results is a long overdue reform, and it shortens the way to the introduction of the Kimberley system of white supervisors on day's pay and natives on contract—the only economically sound system under the conditions prevailing on the Rand.

The hammer-drill is coming more and more into use. The latest and best claimant for recognition is the Atlas drill, a machine of simple construction weighing 75 lb. employing hollow steel with water feed. In Sweden, where it is manufactured, it has ousted the reciprocating drill from the iron mines. Information is now to hand in the annual report of the New Unified summarizing the results of the tests made in that mine to ascertain its stoping capabilities: Machine shifts 231, fathoms broken 275·6, fathoms per machine shift 1·19, average stoping-width 45·68 in., tonnage broken 3148, tonnage per machine-shift 13·63. A big piston-drill will break from 10 to 12 tons per shift in ordinary work, which is below the duty of the Atlas, besides using much more air, creating dust, making a terrible din, and being unwieldy to handle. During the period of the tests reliable data were unobtainable with regard to the cost of maintenance, but this is not expected to be excessive. Should this expectation be realized the prospect before the hammer-drill will be immense, for the Atlas is by no means the last word in hammer-drill design. Mr. J. G. Lawn, consulting engineer to the Barnato group, in commenting on these results says: "Indeed, it is felt that they are so significant that the experiments may have an effect on future methods in many mines on the Rand." Certainly it would appear that a decided advance has been made, for an economical one-man stoping-drill will do more than anything else to neutralize the effect of labour shortage; but at the same time it may be as well to point out that the particular drill under discussion has not yet made good to the satisfaction of everybody; more time must elapse before a definite verdict can be given.

Recovery-value, as applied to the ore reserve of a Rand mine, does not mean the recovery that will be obtained from the ore reserve by itself, but from it when mixed with ore from sources not taken into account in the ore-reserve statement. In other words, a mine never draws all its milling ore from its ore reserve, and in calculating the recovery value of a mine as a whole the amount and value of the ore derived from every contributory source must be taken into account. It is therefore necessary to give due weight to the effect exercised by the additional ore from development faces, stripping, reclamation, and surface dumps. To illustrate the incidence of the various factors a simple generalized calculation is here given, it being assumed that the mine under discussion has an ore reserve of a stoping value of 7·0 dwt. and a sorting ratio of 10%.

Contributory proportion	Value dwt.	Ton dwt.
80 tons from ore reserve	@ 7·0	= 5640·0
7 ,, ,, development	@ 3·5	= 24·5
13 ,, ,, other sources	@ 5·0	= 65·0
100 ,, to sorting station	@ 5·73	= 5729·5
10 ,, of waste sorted out	@ 0·00	= 0·0
90 ,, sent to mill	@ 6·37	= 5729·5

95% metallurgical extraction on 6·37 dwt. = 6·05 dwt. = 25s. 5d.

So that a mine possessing a profitable ore reserve of 7·0 dwt. stoping-value and sorting 10% may be expected to show a recovery-value of 25s. 5d. per ton crushed. Taking other sorting-ratios of 5%, 15%, and 20%, the recovery-value works out at 25s. 4d., 28s. 4d., and 30s. 1d. respectively per ton crushed.

The Machavie gold mine is a modest concern with a capital of £85,000 situated in the Klerksdorp district. The plant consists of 10 Californian and 4 Nissen stamps, amalgamating tables, Wilfley tables, cone-separators, tube-mill, and cyanide works. During the period July to December, 1913, 17,812 tons of 9·38 dwt. ore was crushed. The recovery was 47·3% from the mill, 22·4% from concentrate, and 6·7% from the cyanide works, or a total extraction of 76·4%. The extraction was affected by the gold absorbed in conditioning the plant, and particularly by the presence of much carbonaceous matter, which led to re-precipitation when too long a contact was given in the cyanide vats. The original designers of the plant foresaw this and arranged for agitation and rapid filtration, but unfortunately the means provided to carry out this work proved inadequate, and the decantation method had therefore to be used with a resulting poor extraction. The charge averaged 2·27 dwt., and the residue 1·33 dwt., a theoretical extraction of 41·4% as compared with Rand cyanide extractions of from 85 to 90%. The gas-engine plant and water supply further embarrassed matters by falling short of requirements. In consequence of these disabilities the net working profit amounted to only £3601. The mine, which starts from an outcrop, is opening up well and there is now a fully proved ore reserve of 40,474 tons of 8·9 dwt. over a stoping-width of 49 inches. It is to be hoped that the surface difficulties will be soon overcome and the mine given an opportunity of proving its worth; and that attention will thereby be drawn to a much neglected district.

NEW YORK.

Mexico.—The present situation in Mexico is, of course, the leading theme of interest among mining men in the United States. Following the seizure of Vera Cruz the situation became so tense that it was necessary for the American mining companies to shut-down completely. The Greene-Cananea Copper Co. withdrew all its men from its plant at Cananea, leaving a few of its trusted Mexican employees in charge. There is little danger that the plant there will sustain damage, since the area has for some time been in the hands of the Constitutionalists (who are friendly to the company) and there is little danger that they will be driven back by the Federal forces. The Phelps-Dodge properties at Nacozari are also shut-down and all the American employees have withdrawn to Arizona. The last of the American Smelting & Refining Co's. plants has been closed as well. A good many of the smelters and some of the mines have been closed for some time, but the plants at Chihuahua and Aguascalientes have so far been able to keep in fairly steady operation. All the American employees have now been withdrawn. The United States Smelting & Mining Co. so far has been one of the least affected by revolutionary activities, but now that practically a state of war exists it will probably have to withdraw as well, though the latest word from Pachuca is to the effect that the properties there are operating uninterruptedly. The effect on the United States company is apt to be much greater than on the American since a large part of the United States company's revenue is derived from its Mexican investments. The American Smelting & Refining Co., on the other hand, according to a statement recently made by Daniel Guggenheim, will be able to pay its dividends this year just as easily as though its Mexican operations were not interfered with. As a matter of fact, the American company has been concentrating its efforts on its plants in the United States for some time. The Greene-Cananea is the most affected, since it has only been running at about two-thirds capacity for the past year and will now likely be shut-down for a corresponding period.

Copper.—A question related to the Mexican situation is the effect it is likely to have on the copper market, which has been exceedingly dull for some time past. Those with optimistic views are inclined to think that the cessation of the Mexican output is likely to cause a considerable stiffening of prices ; this is a rather extreme view to take, since the whole output of the Greene-Cananea is not much greater than the difference between the February and March output of the Utah Copper, and similarly the part of the Phelps-Dodge output which is drawn from its Mexican mines is little greater than the difference between the January and February output of that company. The varying views of those who are interested in the copper market are exceedingly interesting. One large producer has recently been quoted as stating that copper during the past few years has chiefly gone into replacements, repairs, and maintenance, very little having been used for new construction, and expresses the belief that the new construction now impending will involve the use of many million pounds of copper. The moral of this is, of course, that a time is likely to come soon when the demand for copper will greatly exceed the visible supply. The market for the metal, however, does not at all respond even to such reports as this and the metal-sellers say that the market is duller than it has been for years.

The impending sale of the International Smelting & Refining Company to the Anaconda is an interesting example of the tendency of the copper business to become concentrated. Of course, the International is already closely related to the Anaconda, for nearly half of its stock is held by the United Metals Selling Co., which is owned by the Amalgamated, which also owns the Anaconda. E. P. Mathewson, the manager of the Anaconda smelter, was for some time general manager for the International Smelting & Refining Co. and was succeeded about a year ago in that position by W. D. Wraith, who had been the superintendent of the Anaconda smelter. The present move is doubtless precipitated by the intention of the International to begin to build a copper smelter in the Globe district of Arizona in order to handle the concentrate produced by the Inspiration and Miami mines. The Amalgamated has a large interest in the Inspiration, and it is but natural that it should also wish to control more directly the smelting company. The International has done well since its formation, although it has had a rather peculiar history. It started as a copper smelting company, expecting to handle the ores of the Bingham district at its smelting plant at Tooele, Utah. Unfortunately the copper mines did not produce anything like the tonnage of ore expected and the copper smelting equipment at Tooele has never been run at more than a fraction of its total capacity. Meanwhile an unexpectedly large supply of lead ore, both from Utah and Idaho, became available at prices that offered the possibilities of good business. A lead-smelting plant was added, and developed so well that a lead refinery was built later near Chicago. The company, on the whole, has been prosperous. Now that it is about to build another plant some new financing will be necessary, and since business conditions are not specially good just now the easiest way is to get it out of the large cash surplus of the Anaconda. The proposed arrangement is that 3·3 shares of Anaconda stock shall be given for each share of International, and as the former is par at $25 and the latter at $100, this places the exchange practically on the basis of their present relative market-prices. A special meeting of the International stock-holders has been called for May 28 to ratify the sale, but there can be no doubt that it will go through. The smelting plant at Globe, as I have remarked already, will consist of reverberatory smelting of the concentrate and converting of the matte. The concentrate is rather low in sulphur, so that it is necessary to make a 50% matte. In order to secure the maximum economy in operating, Wedge roasting furnaces will be used, but they will be operated in such a way as merely to dry and pre-heat the concentrate before going to the reverberatory furnace, without eliminating any of the sulphur present. Encouraging reports come from the flotation plant of the Inspiration. The process used there is a combination of wet concentration and flotation. About one-third of the concentrate is recovered in the ordinary way and the other two-thirds by flotation. The results obtained in the recent operation of the plant indicated a saving of about 82% of the copper present. A good part of the copper lost is in the form of oxidized material, and the eventual hope is that some leaching process will be devised to make an even higher total recovery.

of restrictions and qualifications are put forward to give the landlord an unfair and unreasonable advantage, and the negotiations for their removal from the draft lease continue for many weary months at the expense of the lessee. An instance in point was mentioned by the chairman of the East Pool & Agar company. In the new draft lease of the East Pool section no provision was made to enable the company to surrender on reasonable notice. To secure what is an obviously reasonable protection on this score involved the company in negotiations for three months. Of course all our landlords are not tarred with the same brush, but the great majority seem to have little regard for the development of the mining industry, and rather than grant reasonable terms prefer to see the mines idle. The point I want to make is that the interests of the industry would best be served either by the nationalization of the mines, or by the establishment of an independent tribunal to which lessees, or would-be lessees, could appeal against the often arbitrary decisions of the landlords or their agents, such a tribunal to have full powers to legally enforce its decisions; in fact, to set up similar machinery to the land courts proposed by the Government.

On the Trail, in Mexico.

CAMBORNE.

Mineral ' Lords.'—There has been of late one or two forcible illustrations of the difficulties placed by owners of mineral rights, or their representatives, in the way of those anxious, or at any rate willing, to exploit mineral areas in the county. At East Pool it has taken fifteen months for the new company to come to terms as to a new lease with the representatives of the owner of the East Pool section, and the negotiations have cost the shareholders a large sum of money, most of which has gone into the pockets of the lawyers. The chairman of the company aptly described these negotiations "as an extraordinary exemplification of elongated procrastination." At Levant, too, negotiations with the Crown authorities have been continued for many months for a renewal of the present lease, but little progress seems to be made. Those who have had to negotiate leases with some Cornish landlords are well acquainted with these difficulties. All sorts

Cornish Mining Methods.—The mayor of Truro, Mr. Isaac Roskelly, in an after-dinner speech, at a banquet organized for the purpose of entertaining representatives of the Worshipful Company of Tin-plate Workers who were visiting Cornwall, and in what I can only suggest was a rash moment, made a sweeping attack on the management of Cornish mines, which has resulted in a flood or oratory—most of it not very convincing—in defence. Mr. Roskelly made a comparison between working costs on the Rand and in Cornwall, criticized in no unmeasured terms the efficiency of Cornish mills, and finally suggested that generally the management left something to be desired. Unqualified criticism of this character seldom serves any useful purpose, for the really useful part of the criticism is usually overlooked in the annoyance caused to those concerned. The comparison between the South African gold-mining industry and the Cornish tin-mining industry, where many conditions are so widely different, was not convincing to practical men, but some of his criticisms on milling deserve attention. He suggested that the mill management in Cornwall was inefficient and that the duty per stamp was, as a consequence, abnormally low. This criticism doubtless does apply in several mines, but he ought to have given credit for the excellent work done, for instance, in the South Crofty and East Pool mills. Then he touched on the much discussed question of dressing losses, and here certainly there is room for criticism in a large percentage of the mines, for adequate attention is not often paid to this matter. Mr. Roskelly laid down his own idea as to the qualifications of a man who would take over the management of a mine, and few will quarrel with his definition, but he overlooked the fact that of recent years a far better type of manager has been brought into Cornwall. The trouble in the past has been that directorates have overlooked the fact that they must pay good salaries to secure brains and knowledge.

Dolcoath.—It is probable that Cornwall's premier mine has made no profit, indeed, more likely a loss, for the first sixteen weeks of the current half-year. From a comparison with the figures for the same period for the previous half-year, and if we assume that the working cost is still 25s. per ton (as it was, excluding depreciation, for the last half-year), the total cost figures at £45,731, while the receipts from sales amounted to £43,303. There may be a few odd hundreds received in rents, dividends, etc., but unless the working cost has been substantially reduced, and so far as can be judged from the manager's speeches from time to time this is not possible if development expenditure is excluded, then a loss must have unfortunately been made. The drop in the price of tin of course is largely responsible for this state of affairs, there is also a reduction in the sales, due to a fall in the yield in some of the principal stopes. The developments in the bottom show no improvement.

Basset Mines.—The accounts for the year 1913 show a profit of £2631, excluding depreciation written-off to the extent of £2253, while nothing has been charged for directors' fees. The financial position of the company is sound, for its investments stand at £23,812, while its other assets are more than equal to the liabilities. The comparative statement given below clearly shows that but for the drop in the price of tin, a handsome profit would have been realized, for the increase in the production was no less than 72½ tons. The working cost is set down 9d. per ton, due largely to a reduction in the development and to the increase in the tonnage handled. It is a great pity, as Mr. Francis Oats pointed out, that the output cannot be increased, for with abnormal pumping charges, it is obviously desirable to keep the mill going at its fullest capacity. But lack of miners, and dearth of places to put many more, if secured, explains the small output. The developments in the bottom of the mine seem to have been more promising than for some years past. The manager continues in his report to give the monetary value of the lodes, and the cost for driving or stoping, though what useful purpose such information serves it is difficult to understand, and he omits entirely all references to width and assay-values.

	1912	1913
Tonnage milled	46,646	51,087
Black tin recovered	502 tons	574½ tons
Recovery	24·1 lb.	25·2 lb.
Average price secured	£131·4	£117·8
Average value per ton milled	28s. 4d.	26s. 6d.
Working cost per ton	26s. 9d.	25s. 11d.
Development footage	4236	3804

Wheal Kitty & Penhalls.—The returns from this property show some improvement, although the heavy fall in the price of tin is a serious offset.

	16 Weeks ended Dec 31, 1913	16 Weeks ended April 18, 1914
Tons milled	4520	5055
Black tin recovered, tons	67·3	75·3
,, ,, per ton milled, lb.	30·9	33·3

It has been decided to install a new battery consisting of 20 heads of Californian stamps: presumably the existing Cornish battery will then be scrapped. Amos Treloar has recently been appointed local manager.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

April 1914	March 1914	April 1913
£64. 17s. 4d.	£64. 8s. 1d.	£68. 4s. 10d.

The market has been under the influence of two adverse factors, the shadow of war in America and the increase in European stocks. The former has made buyers cautious and the latter made sellers eager. Nevertheless prices show quite a notable steadiness. Although always feared and constantly predicted, there is no decline apparent in the prosperity of the industry, at least in Europe. Conditions in America are less satisfactory; apart from the uncertainties of the Mexican situation, legal sanction of freight increases is anxiously awaited, and until it is forthcoming capital seems little inclined to assist in obtaining the required renewals of railway equipment.

Standard copper has declined during the month, the net fall amounting to 45s. There has been a considerable amount of bear selling, but the market has stood it well. The bear account open must be substantial, but sentiment and politics assist operators for the fall. Electrolytic copper has followed the movement in standard, the price having dropped from £67. 10s. to £65. 10s. in this country, and from 14½ c. to 14¼ c. in America. The reduction of prices by American producers coincided with a better sentiment on this side, and it is understood that in consequence heavy sales were made. The readiness with which sellers reduced their price rather discouraged the rise, and led to some short selling. The future of the market is obscure; the marked increase in American production combined with the development of African copper mining indicates no shortness of the metal, but the world finds room for it all.

TIN.

Average prices of cash standard tin:

April 1914	March 1914	April 1913
£164. 3s. 7d.	£174. 0s. 1d.	£224. 14s. 2d.

The long continued drop in prices does not even now seem to have ended. The position is giving rise to a good deal of anxiety, not only among mining men, but also on the metal exchange, where the differences that have to be met by dealers have become heavy. The decrease of 1465 tons in the visible supply shown at the end of April corresponded with expectations, and has not stopped the decline; indeed since then the fall has been continuous, down to £153. Though pessimism is so rampant, the turn is doubtless not far off. The Straits has met the market with discouraging readiness, and forced realizations of stale bulls have precipitated the collapse.

LEAD.

Average prices of soft foreign lead:

April 1914	March 1914	April 1913
£17. 19s. 8d.	£19. 2s. 3d.	£17. 8s. 10d.

The fall chronicled in our last issue has been succeeded by a steady tone. There are persistent complaints of bad trade from manufacturers, yet the demand shows little abatement. Bears who have venturously attacked the market ever since the break in March, deferred covering their April deliveries until late in the month, so that while inquiry was long stagnant, it became active after the turn of the month. The American quotation has been raised from 3·80 to 3·90 c. which is well above English parity, so there is no present likelihood of American imports. The raising of the price was followed by a short-lived flurry, but a stronger and more settled feeling now prevails. The great question of supplies remains the ruling factor as to further market developments.

SPELTER.

Average prices of good ordinary brands:

April 1914	March 1914	April 1913
£21. 10s. 1d.	£21. 7s. 7d.	£25. 2s. 4d.

Trade has shown little activity and prices continue steady. At the meeting of the syndicate, it was decided to made a reduction of 10s. per ton, but at the same time to restrict the output. An active spurt of buying followed, but it has not lasted, and the market is settling once more into dulness.

OTHER METALS AND MINERALS.

Prices quoted on May 10:

SILVER.—27d. per oz., standard.

PLATINUM.—185s. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£81 to £83 per ton.

NICKEL.—£170 per ton.

ANTIMONY.—£29 to £30 per ton.

ARSENIC, WHITE.—£13. 12s. 6d. per ton.

QUICKSILVER.—£7 per flask.

MANGANESE ORE.—8½d. to 9½d. per unit.

IRON ORE. — Cumberland hematite 19s. per ton at mine. Spanish 18s. delivered.

PIG IRON.—Cleveland 51s. 6d. per ton. Hematite 61s. per ton.

WOLFRAM ORE.—33s. per unit (1%).

DISCUSSION

Antarctic Exploration.

The Editor:

Sir—Though some of your readers may agree with Mr. Alfred H. Brooks in thinking that your own remarks on the above subject were too severe, there must be many more who, like myself, cordially agree with everything in your editorial of January, 1914, and in the previous one of March, 1913, and who admire your outspoken criticisms, the more so perhaps because, though your remarks were abundantly justified, you took an unpopular view of the matter.

You say that the Northern diggers make their long crossings for money, and hence are not amateurs. Are the Polar explorers amateurs, and is there no money coming in from lectures, cinema shows, and from the sale of books and surplus postage stamps?

As many of your readers know from experience, real exploration is hard work, full of risks and major or minor discomforts, which are probably no greater at the Poles than in the Tropics, merely they are different. I imagine that it must be uncomfortable to be very cold for long periods. I know that it is uncomfortable to be wet or hot for considerable periods. It must be an awful experience to sit down alone in the Polar regions to face death from starvation, but perhaps some of your readers may have come near to a similar fate in the Tropics. Certainly there are many instances of prospectors and others who, being 'bushed,' have lost their reason or even perished from hunger or thirst, and there will probably be some who, under somewhat similar circumstances and in the course of their work, have 'won through' after having lost all hope. If there are any such they will probably be able to assure you that their experiences were harrowing, and that the contemplation of death from starvation, when alone, is no more pleasant in the Tropics than at the Poles. Polar exploration may be desirable; it may be necessary. There are many other schemes which are both to a greater degree and yet have to wait, but if such exploration is to go forward let it go under true colours, and give up the pretence that it is the only exploration which is difficult or dangerous, or that it is all undertaken for science or for love of country. It is just as you, Sir, have stated. Moreover, Polar exploration properly managed should be infinitely less risky than much other exploratory work.

In Polar regions the chief dangers peculiar to the country are from scurvy or frost-bite, both due to preventable causes, and these may be compared to beri-beri and sunstroke in the Tropics; but in the latter regions there are many more dangers, for instance, attacks from wild animals, snake-bites, and the following among other sicknesses, namely, malaria, blackwater fever, cholera, and leprosy.

STEPHEN J. LETT.

London, April 18.

Partners.

The Editor:

Sir—I notice in your editorial of last month on the subject of ore that you refer to the metallurgist as the "junior partner" of the miner. Surely this is quite an inadvertent animadversion on your part on the true status of the metallurgist in his relationship with the mining engineer. It is unfortunately the fact that the closely reasoned and frequently laborious efforts of the metallurgist are commonly the subject of disparagement on the part of the general public, while valuable discoveries of mineral wealth, of a more or less fortuitous character, give a spectacular appearance of mining engineering skill that, in point of fact, frequently does not exist. There is also a well known aphorism, to the effect that it is the mine that makes the mining engineer, that is by no means devoid of a measure of truth. Fortune tends to favour the position of the mining engineer in the eyes of the public, but the metallurgist requires some modicum of brains and scientific attainment if he is to establish and maintain a reputation. Historically, too, it was not until metallurgy was a fairly advanced art that it was found necessary to dig beneath the earth's surface or mine for the necessary metalliferous material for the metallurgist's activities, so that on this ground the metallurgist might reasonably plead seniority. A discussion on the subject of seniority of partnership would be invidious at the present time if the highly developed state of both arts is duly considered, but might I suggest that, in the interest of the metallurgical fraternity, you eliminate the little word junior and thereby withdraw your implied support of a popular fallacy that rests hardly on the skilled metallurgist.

WM. H. GOODCHILD.

London, April 22.

[Yes, it would be invidious to discuss the matter. The metallurgist is junior to the extent only that the ore has to be found by the miner or the mining engineer before the metallurgist can exercise his skill.—EDITOR.]

The Copper Country Strike.

The Editor:

Sir—In such a controversy, it is difficult to express points of view without arousing denials from one side or the other. Naturally, the men directly concerned are liable to be prejudiced and, on account of the vigorous Lake Superior temperament, emphatically so. When the strike was first called, it was not generally thought it would persist so long or so bitterly; indeed, surprise was expressed that a strike was possible in a district so well administered.

The investigations of sundry parties have brought out very little that most mining men did not already know; on the other hand, the sudden and savage developments between strikers and opponents have been surprising, even to those familiar with the type of men concerned. The deportation of Moyer was poor policy on the part of the citizens and mine officials, because it aroused sympathy and tangible evidence for the strikers. But in the Lake Superior country this summary mode of dealing with outside strike-leaders has been much commended, and many have remarked that if the mining companies had shown such a spirit sooner a better understanding would have resulted. Some even remark that the early attitude of the mining companies was a "holier-than-thou" pose, which, if true, was bound to be peculiarly aggravating to the strikers.

There can be no doubt that so far as community benefits go, the mining companies have been particularly generous. But when a company is kind in a community way, it may have less time to be considerate in an individual way, and minor injustices may have been let go which are scouted by the officials, but which linger in a miner's memory. I think it was Mr. Mark R. Lamb who once contributed an article to a mining weekly on 'The Gentle Art of Appreciation.' In a given mining community it is not always the club-house-giving company that attracts the best miners.

When the strike began and for several weeks afterward, general opinion seemed to favour the companies, for the miners did not have any definite claims as to mis-treatment. This meant that they actually were in the wrong, or that their grievances were difficult to express to an outsider. The strike has lasted so long, and, for a time, had such a serious aspect, that it is reasonable to suppose the miners had what they considered good and sufficient cause. As there appears to be no big grievances, it must be that there were a lot of continued little grievances. Now, strange as it may seem, miners frequently exhibit as much discontent over a number of small wrongs as over a few large ones. It may be argued that in any large industry there will be certain individuals wronged, but it all comes back to that state of mind called by Mr. Lamb the 'Gentle Art of Appreciation.'

Some discussions of the strike question have indicated that the introduction of efficiency engineering, begun several years ago, was a direct cause of the strike. If so, it is evident that what the companies saved by scientific management they have lost by discontent. However, it would appear that efficiency engineering is not to be blamed in the abstract so much as the wrong ideas regarding it. There are some miners who are so constituted (many of them first-rate miners too) that it seems they never can and never will work well when they know a man is recording their actions, time taken for this and that, etc. Of course, this is a wrong idea. On the other hand, there are some superintendents who think efficiency engineering consists in reducing the cost per ton regardless of how it is achieved, but mostly by hiring a man to time the drilling and shovelling and to "punch the men up." This also is a wrong idea. Not but what records of drilling, etc., are all right in an effort to lower costs, but continued efficiency in a mine, year in and year out, is to a large degree dependent upon the management itself and its understanding of the men who do the work.

The argument that the mining companies

are in the wrong because the Calumet & Hecla has paid such high dividends on such small capital is no argument at all. Mr. Taft would perhaps even style such logic 'hysteria.' On the face of it, all minerals in the earth's crust cannot be extracted at an exactly equal cost; the Calumet conglomerate happened to be for a number of years more easily turned into commercial copper than the ore of the mines then competing with it. The geographic position, the ore occurrence, the ease of smelting, etc., of all the copper deposits cannot be the same; some have to be better and others worse. It happened that certain Boston gentlemen (who had as much right as anyone else) secured the Calumet & Hecla, administered it well, and economic conditions were such that large dividends were possible.

P. B. McDONALD.

New York, March 3.

Hydrocyanic Acid as a Solvent for Gold.

The Editor:

Sir—Mr. H. T. Lambert contributes a letter on the above subject in your February number.

I agree with the writer as far as he goes, but I went farther than that some years ago in some experiments I made. First of all I proved that gold leaf was not soluble in pure distilled water with hydrocyanic acid passing through. Then I tried ferrous salts, slightly acid, and no oxygen present. The gold leaf remained unaffected. Then I tried ferric sulphate and ferric chloride in a slightly acid solution, and the gold leaf slowly disappeared.

ANDREW F. CROSSE.

Johannesburg, March 26.

Graphite as a Precipitant of Gold from Cyanide Solution.

The Editor:

Sir—The part played by graphite in the processes of extracting gold from its ores is one of interest and often causes considerable trouble to cyanide metallurgists, as is evidenced by Mr. H. E. West's letter in your February issue. That graphite could coat particles of gold with a thin film and so prevent them from being caught on amalgamated plates, or even dissolved by a cyanide solution, is easily believable, but it does not seem possible that a substance so chemically inert at ordinary temperatures could precipitate gold from cold dilute cyanide solutions. And unless the graphite were derived from organic matter and retained the original minutely cellular structure, like charcoal, it could hardly occlude sufficient gas to do much harm. In many mines the wall-rock contains a shale or schist with a black shiny fracture, strongly reminding one of a blackleaded kitchen stove, and if in the subsequent treatment of the ore a bad extraction results, the graphite is promptly held to be the culprit. A case of this kind occurred on a gold-silver mine in Mexico, where some of the rich ore was so intermixed with a so-called black slate that separation by sorting was impracticable. Whenever this ore was sent to the mill the metal left in the tailing at once rose, and some experiments were made to find a remedy. First, as graphite was suspected, some gold-bearing solution was agitated with powdered plumbago crucible, and also with Nixey's blacklead, as described by Mr. West, but in neither case was there any precipitation of the gold or silver. The black slate, however, was able to precipitate the gold, but not the silver, and if sufficient solution were present, would reach a value of 13 dwt. gold per ton. The following shows the result of one experiment:

	Gold Dwt.	Silver Oz.	Cyanide %	Lime lb.
Solution.				
Before agitation.......	1·42	0·72	0·036	1·24
After ,, ...	0·60	0·70	0·032	0·16
Slate.				
Before agitation.......	0·08	0·28		
After ,, ...	13·02	1·30		

Subsequent agitation of this slate with fresh cyanide solution failed to re-dissolve any of the gold. Increasing the cyanide strength of the original solution or giving the slate a preliminary wash with lead-acetate solution proved worse than useless, increasing the speed of precipitation, as it does in zinc-box work, while heating the slate to dull redness to drive off any occluded gas only improved matters very slightly. This seemed to dispose of the graphite and occluded gas theory, though no other could be given unless it were that, while *pure* graphite is not a precipitant, in an ore some element or mineral might be present, which, forming with graphite a galvanic couple, would cause the precipitation of the gold.

Why not re-precipitation? It is a technical term that conveys a definite meaning to cyanide operators, and, though premature precipitation is doubtless more strictly accurate it is too much of the prunes-and-prisms order for everyday use. Surely a meticulous precision is a little desirable in the language as in the other operations of mining.

T. B. GREENFIELD.

Morriston, South India, April 8.

Cumberland Hematite.

The Editor:

Sir—In your magazine for April I note therein a classification table appended to Dr. Hatch's presidential address. As a reader I feel grateful for such a table, for it enables one more readily to assimilate the writer's intention; also in studying a new deposit a copy of it in note-book form would afford a quick way of summarizing in concrete form the leading features of the deposit. But as a Cumbrian I must take exception to that part which mentions "cavity-filling such as the hematite deposits of Cumberland." A recent book on mineralogy also makes the above statement when referring to hematite. It is time this fossilized illusion was dispelled. The hematite deposits of Cumberland constitute one of the most typical replacement deposits to be found anywhere. J. D. Kendall, in his book 'The Iron Ores of Great Britain,' proves beyond all doubt that these cavities could not have remained open. Subsidence takes place during the stoping of many orebodies; it often proves a difficult matter to keep the workings open. Beds of shale in some cases overlie the ore. This shale has to be timbered as soon as possible; if more than a few feet remain open it collapses. Mr. Kendall also gives the theory of displacement or substitution as the origin of the ores. This was when the replacement theory was in its infancy. Since that time we have travelled far. J. D. Irving's paper on replacement deposits has put this theory beyond the pale of controversy. The Cumberland deposits have suffered greatly at the hands of scribes, who, with a very superficial knowledge of geology, have hastened to describe the deposits. Every conceivable theory at one time or another has been enumerated without a scrap of evidence to show why they were advanced. Hence the impression has gone abroad that the deposits are filled cavities. Briefly, I maintain that the facts prove these deposits to be epigenetic replacements. First, I shall attempt to show the deposits are later than the Carboniferous limestone in which they are found. (1) This is demonstrated by the fact that the ore is found within movement-planes or adjacent to them, the faulting having produced the necessary fissures to act as solution-channels. This faulting could not have taken place until after the deposition of the limestone. (2) Proof that the fault-planes have acted as solution-channels is to be found in many places on surface. At a distance from the larger faults the effect of the tension on the strata is shown by a slight fissuring of the rocks. For a few inches on each side of the tension-fractures the rock has been replaced by hematite, showing that the solutions carrying the ore must have passed along these channels. It is inconceivable that if the ore were contemporaneous with the rock it would have confined itself to the fissuring now shown. (3) The transition from ore to limestone, as shown from a number of microscopical sections, is in some cases abrupt, but as a general rule takes place within a few inches. Outside this area we have a pure limestone. Had the ore and limestone been deposited together we should expect to find the limestone contaminated with ore for a considerable distance, and, the hematite being consistent and uniform over large areas, gradually merging from finely disseminated ore to a pure limestone. (4) May it be adduced from the fact that in some cases along the fault-plane the ore has the Permian breccia as one of the wall-rocks? It now remains to show why these deposits are not filled cavities, although it is preposterous to think how such a theory could have been formulated, as there is not a scrap of evidence to support it. None of the phenomena that usually accompany solution-cavities in limestone are to be found in the rocks that envelop the hematite. In certain parts of the limestone solution-cavities are found. They have a concave and convex appearance, which gives a rounded and smooth surface conforming to the concavity or convexity of the rock. However, we want something more positive than this, and with this end in view the following facts are enumerated. (1) It is not an uncommon occurrence to find thin bands of shale running right across the ore. It is difficult to see how these could have originated in a filled cavity. The solutions carrying the ore must have ceased for some time, and their place taken by solutions carrying matter in suspension. (2) Pieces of limestone varying greatly in size are found within the ore, and having no connection with the limestone outside. How are the supporters of the cavity theory to account for these? The only possible assumption is that they have fallen during the time the cavity was being filled with ore, and thus became imbedded with it. If these falls occurred during the time the cavity was filling, then it is feasible to assume falls must have taken place before ore deposition started, and we would find evidence of it in the shape of cross and angular bedding at the bottom of the cavities, of which there is none. (3) I have in my possession about a dozen fossils, most of which are entirely replaced by hematite. They consist of *productus*, corals, and encrinites, all of which are characteristic of the Carboniferous limestone. The *productus* vary in size, and all, except one, were entirely replaced by hematite. The encrinites lie imbedded in ore. One is four inches long, one inch is replaced by hematite, and the other end remains intact. The corals are found in all conditions. They lie imbedded in ore. Some are entirely replaced, gradually merging backward to a few that have remained unattacked. In the examination of sections, *foraminifera* are to be found in all stages of replacement, from those that show only the smallest trace of ore up to entire replacement. A great deal more could be written, but I think the above proves conclusively that these deposits are epigenetic replacements.

WILLIAM McDONALD.

Moor Row, Cumberland, April 28.

Ore.

The Editor:

Sir—With reference to the discussion on the above, which is being carried on by your good magazine, I beg to submit the following:

I think the idea of profit should be eliminated from the meaning of the word, for, as pointed out by Mr. William McDonald in his article appearing in your March issue, two adjoining properties, working upon material of identically the same chemical composition, may show very different balance-sheets, due to efficiency of management or otherwise. In this case the engineer reporting upon the profitable mine will have made correct use of the word, whereas his confrère who reported upon the adjoining property will have had a technical error thrust upon him by the inefficiency of the management. Again, most frequently the original report upon a property embraces only the material in place, with the estimated cost of delivering same to the reduction plant, the metallurgist being called in to say whether this material can be treated at a profit or not; but it is in the original report that the word ore is so frequently used, and if profit is to be understood the mining engineer, when using this word, must also either be the metallurgical engineer or consult with the metallurgist, before sending in his report, or take chances on the technical error; whereas, if it is understood that the word ore implies solely *any* mineral aggregation, with no profit expressed or implied, the proposition is placed before the parties interested upon a purely business basis. I mean by this that the engineers responsible for the reports dealing with the property supposedly under discussion, must show, in pounds, shillings and pence, why it is a sound business proposition, and leave no loophole for a misunderstanding by the use of a word, the interpretation of which depends upon the reader. The point appears to me to be not so much what the word shall imply as what it shall not. If profit is implied there will always be the chance that some person, ignorant of mining, may be influenced to invest, just as the sight of 'high-grade' will draw dollars from the pocket of the unthinking man into the hands of the unscrupulous mining stock-vendor. However, the question is of sufficient interest for the mining associations to take up with a view to agreeing upon one definite meaning, and this meaning, transferred by them to all schools where mining and metallurgical engineering is taught, would insure unanimity upon this point among coming generations.

A. E. GREGORY.

Telluride, Colorado, April 3.

[This letter is late, but it expresses views contrary to our own, therefore we publish it. Certainly, it is difficult to distinguish between what is ore and what is not ore; that is why mining engineers are employed by non-technical persons. To ascertain whether a mineral is ore is the preliminary step in all intelligent mining operations. If the term be applied to "all mineral aggregations," then it ceases to have technical value, it is no longer a term of precision, and can be rejected without regret. The fact that 'ore' is used as signifying an asset is the reason why it has become necessary to restrict its use to metal-bearing rock that can be exploited to economic advantage.—EDITOR].

The Editor:

Sir—You have now summed up this interesting discussion and given as your final definition: "Ore is metal-bearing rock that can be exploited to economic advantage."

Allow me to observe that your definition does not seem to include metal-bearing rock already broken, perhaps hand-picked, or in course of shipment to the smelter. All similar "mineral aggregates" by universal usage, which—as you agree—is the real touchstone, are called 'ore.'

Further, I submit that the objection to discriminating between the identical products of two mines, possibly working side by side on the same lode, the one at a profit, the other—through causes which may not be overcome for two or three years, if ever—at a loss, is more serious than you make out. Universal usage would certainly describe both products as well as the reserves in both mines as ore.

How strong is usage as against academic rules is shown by your own correspondents in the April number, page 241, 1st column: "Silicious ore" at the Great Cobar (working at a loss) is to be rejected as non-profitable.

Pages 269-270: The product of Carn Brea, East Pool & Agar, and of Levant is called 'ore,' all these mines being worked at a loss.

Page 281, 1st column, line 5: Mr. G. J. Frost calls ore an aggregate of blende and quartz, without giving a thought to its payability and being solely interested in the behaviour of the two minerals when agitated with water.

Professor Lounsbury's teaching on usage should put us on our guard against trying to coerce living language by rules, but if a definition of 'ore' must be given it should not exclude what is everywhere called by that name.

H. LEUPOLD.

Noli, Italy, April 25.

[The first objection is hypercritical. Ore broken is in course of exploitation. Universal usage does not settle the specific usage of technology. If two mines are working side by side, one at a loss, the other at a profit, it is worth while to discriminate as to the character of their products. "Universal usage" confuses the essential difference. No academic rule has been laid down; an effort has been made to express intensely practical considerations. If our correspondents used 'ore' in the ordinary careless way, it was because they had not had the chance to read the April issue of *The Mining Magazine*; in any event, they, and the editor, are still learning.—EDITOR.]

Short Tube-Mills.

The Editor:

Sir—It is generally recognized that the tube-mill is the most satisfactory device where all-sliming is desired. It is also admitted that the conical pebble-mill is the most economical and satisfactory for an intermediate stage of grinding, such as was previously done by Huntington and Chilean mills. In the majority of cases where the ore is being prepared for the various concentrating processes, Hardinge conical pebble-mills are being installed.

The largest size Hardinge pebble-mill is 8 ft. by 30 inches and requires from 35 to 45 h.p. Would not a short tube-mill, 8 ft. diam. and 6 to 8 ft. long, be a more efficient and economical mill? Is there really any advantage gained by a departure from the cylindrical type of tube-mill? I believe the tube-mill can be called upon to do any degree of grinding, depending mainly on the length, diameter, and area of discharge. It should give a granular product to any degree of fineness suitable for concentration processes, provided it is built with the proper dimensions and operated under proper conditions.

A. E. DRUCKER.

London, March 27.

Bisichi.

The Editor:

Sir—In your April number, under your 'Review of Mining,' you criticize both the management in London and Nigeria of the Bisichi Tin Co. (Nigeria), Ltd., and state that "Too much of an eye on the share market is demoralizing to any administration." This sentence is entirely misleading, and, while my management in Nigeria may "leave much to be desired," I can assure you, as manager, that this company in shaping its policy has taken less notice of the share-market than any other company of whose affairs I am cognizant. Certainly, the communications from my board to me as manager have never suggested anything of the kind. Whatever faults you may impute to the administration, this is not one of them.

HORACE P. ROBERTSON,
General Manager, Bisichi Tin Co. (Nigeria), Ltd.

London, May 4.

[We accept this correction unreservedly.—EDITOR.]

Herbert A. Evans.

The Editor:

Sir—It will be a great shock to his many friends to learn that Herbert A. Evans, manager for the London & Pacific Petroleum Co. at Negritos, Peru, passed away on April 28 at the Colon Hospital, Panama, after undergoing a serious operation.

He was at one time manager of the Tolima mine, in Colombia, and was beloved by all those who were associated with him. An engineer of great ability and ingenuity, a friend of all, particularly those in need of advice and sympathy, which he gave wisely and wholeheartedly, your readers will understand his influence for good in a mining camp. His object was to secure harmony and goodwill amongst those with whom he worked, and this object he invariably attained.

Bristol, May 6. H. D. MARTIN.

TYPES OF OLD WORKINGS IN RHODESIA.

Nature of Ancient Excavations. Character of the Deposits. Small Orebodies.

By F. E. B. FRIPP.

I PROPOSE to limit this paper to old workings for gold, occurring between the Limpopo and the Zambesi.

Practically every modern mine in this area resulted from the exploration of ancient workings. The Ophir and the Valley are the only two important exceptions to this, though one might almost add the Lonely, where there was a small old working four feet deep, and eighteen to twenty feet long, but where it seemed evident that no ore had been removed by the 'ancients,' since a mound of quartz with visible gold all through it surrounded this slight excavation. But only a small minority of the old workings were of any size and extent. These naturally attracted first attention. In the early days, disappointment often resulted from the finding, below many big old workings, of very little gold. This affected adversely many of the earlier exploration companies, which were formed under the general idea that the old workers only tried rich lodes, and that such high-grade ore would persist. In consequence of many early failures, the opposite opinion is often held nowadays, namely, that the ancient workers sometimes treated quite low-grade ore. This is based on the comparative poverty of the ore adjacent to old workings, and the medium and even tenour of the ore remaining round and beneath them. Of this, the Wanderer is typical. A point that seems, however, to have been overlooked, is that we have no proof that these shallow workings did not benefit from localized secondary enrichment, which is a characteristic of most deposits in their upper and oxidized zones: the zones to which ancient work was generally confined.

As groups of big old workings, such as the Eldorado, Globe & Phœnix, and Tebekwe, became absorbed by the companies, prospectors had to turn their attention to those of less apparent consequence. In some cases this resulted in the opening-up of lower-grade deposits, such as the Shamva. In such cases, as I believe, the rich patches only had been worked by the 'ancients,' thus appearing as insignificant old workings. On development, the rock intervening between these small old workings was sometimes found to constitute, in the mass, a profitable lode. This was specially noticeable in the case of impregnations, like the Giant, the Wanderer, Shamva, and others. As a rule, groups of big old workings were on quartz veins, as at the Globe & Phœnix, Tebekwe, and Bonsor. These, together with the impregnations, such as the Cam & Motor and Bush Tick, were the origin of practically all the present-day mines of any size. The Eldorado and the Gaika, do not, however, come exactly into either category, the Eldorado 'banket' being in reality a breccia, and the Gaika a stockwork of narrow veins.

The Rhodesian tributor, who later developed into the small mine-owner, started opening and prospecting the less significant old workings. He regarded his own success as quite likely, since his requirements of tonnage were inconsiderable as compared with those of a company.

Intrusive granite rocks constitute by far the largest portion of Rhodesia, the Archean schists which form the gold-belts being insignificant in comparison with the granite. This immense amount of intruded magma caused violent upheavals, fracturing the Archean schist into a multitude of small fissures in every direction. These form the lode-channels. In consequence, the characteristic of Rhodesia is the multitude of small fissures; whereas in those parts of Australia and India where, although similar Archean rocks occur, the bulk-relation of intrusive to Archean rocks is less unequal, the tendency has been toward the formation of fewer but more individually important fissures.

The majority of the smaller Rhodesian old workings appear to occur on fissures at the limit of a movement resulting in cross-fracture or flexure. At first sight, the small deposits appeared likely to have occurred on long faults roughly parallel to the great granite masses intruded into the Archean schist. But on closer examination, a fault, or at least a flexure, is seen to exist across the schist intervening between the lode and the granite mass. The fissure in which the lode occurs is evidently where the thrust forming this cross-fracture ceased to affect the schist, and resulted in a fissure more or less at right-angles to the line of cross-fracture, the mass of schist beyond remaining unaffected. The cross-fractures are the result of the unequal thrust of the intrusive granite, and occur in the schist at many points along the contact of the granite and the schist. This is noticeable all through the country. The banded ironstone, so characteristic a feature of all the gold belts (compare Mennell's geological sketch-maps), shows this faulting or flexure in the neighbourhood of all such deposits as I have described. Such faults or contortions show clearly in this well marked occurrence. Occasional traces of the banded ironstone in the immediate proximity of such faults or contortions may carry gold, from traces upward.

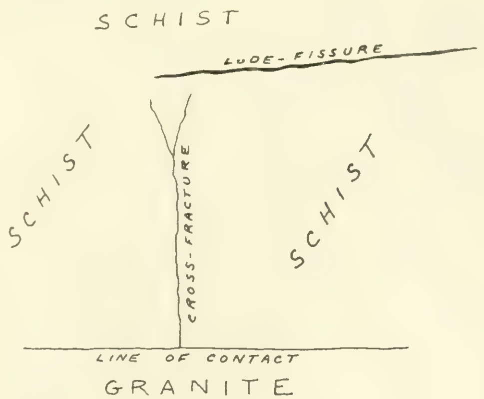
Sometimes the lode-fissure occurs entirely on one side or the other of the cross-fracture, showing which portion of the schist on either side of the cross-fracture has been most thrown. The continued recurrence of this structure along a belt of harder schist roughly parallel with the granite contact has in many cases been mistaken for the typical lode in a main line of shearing.

Where cross-fracturing with displacement by the thrust has not actually taken place, a considerable flexure in the schist is noticeable, as the result of the unequal thrust of the granitic mass. At the limit of this motion also, the small lodes are likely to occur.

Where the faulting has been very considerable, and the cross-fracture has penetrated the schist-mass for some distance, subsidiary fissures, at a big angle to it, may occur in the vicinity of harder belts of rock traversed by the fault. These have given rise to deposits roughly parallel to one another.

In all these three cases, where the cross-fracture cuts pre-existing quartz-lodes abruptly, no mineral deposit is found. But where it has formed its own subsidiary fissures (the result of the thrust motion being absorbed by the mass of rock, either suddenly, or at several points) these were the channels through which mineralization took place. Where such channels have coincided with pre-existing quartz lodes, for some part of their course, mineralization has occurred in these lodes, along the coincidence, in addition to occurring along the lode-fissures. At such junctions with pre-existing quartz veins, more substantial ore-bodies, and pockets of higher value, seem to have been distributed.

Where the subsidiary fissure has not been the occasion for the formation of any lode, it may, however, cross the cleavage of the schist, both in strike and in dip, and in so doing may intersect numerous pre-existing quartz stringers and veins, many of these latter occurring in the cleavage-plane of the schist. Generally, in each such case, mineralization of the stringer or veins has taken place in consequence, often puzzling the worker; patches of ore and ancient workings occur apparently sporadically, with no continuity either in depth or strike. The possibility of further ore being found in such cases depends entirely upon the recurrence of such pre-existing quartz veins being intersected in depth by the mineralizing fissure. With the above conditions, it can be readily understood how the ore-shoots in any given lode can differ from one another, and vary from horizontal zones to vertical, or occur as mere patches.



This tendency to the formation of many small mineral occurrences over a wide-spread area has an economic bearing. In the main, geological conditions such as have been described do not favour the expectation of deposits able to yield a tonnage of ore that will warrant exploitation by the modern large mining corporation. The history of the companies has been that their holdings, after some prospecting, have been let on tribute to the small worker, who has in many cases made a success of them, and has given some return to the company by his royalty. In a few instances, such as the Eiffel Blue, Eileen Alannah, and Queen's mines, the tributor, by his further work, has shown the company that they possessed a mine of some promise.

On the other hand, many individual owners or small syndicates, who find the capital to work their own holdings, have a reasonable chance of success. Examples of the small holdings of individual owners have, however, been deliberately withheld; they are not sufficiently well known to be of interest outside Rhodesia.

LEAD MINING IN SPAIN.

Output. General Geology. Linares. La Carolina.

By E. MACKAY HERIOT.

Introductory.—Spain is considered by many Englishmen as a mining region that is exhausted; nevertheless, it is the second largest lead-producer in the world, with an annual output of over 170,000 tons, the United States coming first with 340,000 tons. Moreover, the country still has resources for lead mining that are only awaiting better transport facilities.

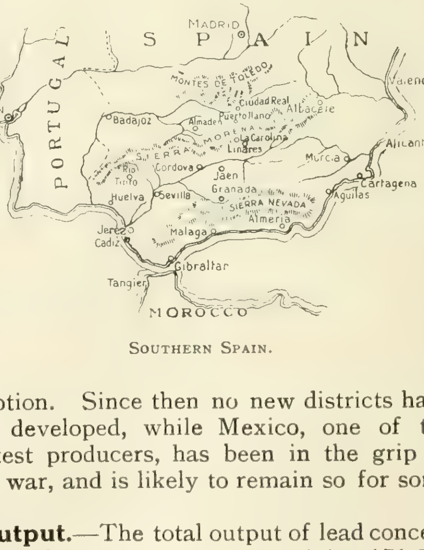
The main lead belt is to be found in the South between the Sierra Moreña and the Sierra Nevada, and it is from comparatively small districts that the bulk of the production is obtained. First and foremost comes La Carolina, in the province of Jaen, with an annual output of 120,000 tons of concentrate. Linares, which adjoins La Carolina, was not many years ago the greatest lead district in Europe.

Passing from here northward across the Sierra Moreña into Cuidad Real we come to a region wholly undeveloped, neglected for want of transport, but containing many outcrops of lead ore. The Penarroya company, a French mining and smelting business, which also operates coal mines and railways, had its engineers prospecting there many years ago. Their policy has been to select properties and await the opportunity for developing. Through one of these districts a railway is shortly to be built. Scattered about the Sierra within a radius of 100 kilometres of La Carolina are the celebrated mines of El Horcajo and San Quintin and the mineralized areas of Veredas and Valle de Alcudia.

In the province of Cordoba there are many rich lead mines with high silver content. In the district of Posadas several silver-lead-zinc mines have been, and are, operated successfully. These mines were worked originally by the Romans 2000 years ago. I have seen their methods of timbering, their lamps and implements, and their pumping apparatus—the archimedean screw. The Romans worked to considerable depth and pumped large quantities of water. In the highlands of Cordoba, near Alcaracejos, are the mines of the Anglo-Vask and Penarroya. The mining districts of Almeria and Cartagena are well known, but both of these are today small producers.

There are seven lead smelters in Spain with a total annual output of 170,000 tons. As far as I can judge, Penarroya controls about 100,000 tons of this. The smelting companies have combined to stop competition in ore-buying. This has been possible, as the government has placed a duty of 10 pesetas per ton (one peseta = 9d.) on the export of lead concentrate.

During the past year the price of lead has been high, and there is no prospect of a fall. In 1911 the output was less than the consumption. Since then no new districts have been developed, while Mexico, one of the greatest producers, has been in the grip of civil war, and is likely to remain so for some time.



Southern Spain.

Output.—The total output of lead concentrate is about 269,878 tons containing 171,000 tons metallic lead. The province of Jaen comes easily first with 140,000 tons of concentrate, or rather over one half the total. Murcia comes next, with only 42,201 tons. The figures for the four chief provinces are as follows:

Provinces.	Tons of concentrate.
Jaen	140,000
Murcia	42,201
Cordoba	23,933
Almeria	19,098

The output of these four provinces accounts for 83% of the total Spanish production. Other mines are at work in the provinces of Ciudad

Real and Badajoz. As already mentioned, Ciudad Real should have a great future as regards its lead mining industry.

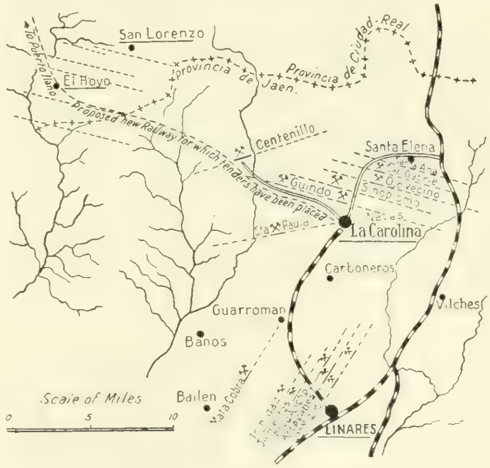
Geology.—In the Linares and Santa Elena districts the lead ores occur in granite, while in La Carolina quartzite and slate predominate. All lodes striking north-south are considered as 'cross-veins.' They are often profitable near the surface, but not at great depth. In La Carolina, lodes with a northeast strike are also cross-veins, similar to those with northerly strike, but in Linares they are main lodes. In La Carolina and Santa Elena the main lodes strike northwest - southeast, or, to be more exact, W. 30° N. By 'main' lodes is meant such as are being successfully worked on a large scale. The ore deposits are more regular when the veins traverse the granite and least regular when in Cambrian slate. This is natural, because the Cambrian slate is soft, and the fissures must have been closed in many places before the mineral was deposited.

In Linares the mines were worked by old methods that were not economical. There is still much lead in Linares, although most of the mines have suspended working. The fact probably is that on account of local conditions the working was so simple and the veins so rich that little trouble was taken to practice economies. The best ore-shoot was that of the Arrayanes state mine which has been exploited over a length of about 2½ miles and to 1500 ft. in depth. There have been many other magnificent ore-shoots, such as those of Coto La Luz, Pozo Ancho, Mata Cabras, and San Miguel. The average thickness of solid sulphide may be taken as 12 centimetres (5 inches). Under ordinary circumstances a little over one inch would pay expenses. As the walls were of solid granite, the ore was easily extracted. As a rule the underhand system of stoping was used, with overhand stoping occasionally. Stope-filling and timbering were practically unknown. The shafts were square in shape, some timbered and some not. Cornish pumps served to raise the water. There is still one old beam-engine at work at Pozo Ancho.

The gangue accompanying the ore is granite, quartz, and calcite. Mechanical concentration plants were seldom used. Working by hand, the treatment per ton of concentrate was from 5 to 10 pesetas, and an 80% product was obtained. As a rule most dumps, more especially the fine, have been re-washed by tributers, who played a great part in the Linares mines. Larger companies often leased a considerable portion of the upper workings to men who formed small companies on their own, and many fortunes were made in this way.

No one has attempted to prove the ore to great depth. The deepest mine is 1800 ft., and has rich ore at bottom; others are poorer. The usual reason for not going deep is that there are sterile zones. The first occurs at 300 to 450 ft., the second at 750 to 900 ft., and the third at 1500 ft. This latter has been the great barrier, and against it few have tried to force a way.

Linares is a large town with 45,000 inhabitants, two large foundries, and three smelters. The last have an annual output of 50,000 tons of lead. Most of the ore comes from La



LINARES—LA CAROLINA DISTRICT.

Carolina. Why the smelters were erected at Linares is not apparent; the right place for them would be at some seaport, such as Malaga, where lime and ironstone are mined locally, and the coke obtained direct from the incoming ships. The cost of coke represents one-fifth of the total smelter charges.

Of late there has been a considerable change in local smelter interests, following the absorption by the Penarroya of the Escombrera-Bleiberg and Figueroa. This makes Penarroya's lead output considerably over 100,000 tons per year. The output of the two Broken Hill smelters is 82,000 tons.

La Carolina.—This township lies on the south side of the Sierra. It has 20,000 inhabitants, and has lately been joined to Linares by rail. Santa Elena, the eastern part, is served by the main line from Madrid to Seville, which passes three miles farther east. Three of the larger mines use aerial ropeways to communicate with the railway.

The mine farthest west is the New Centenillo, owned in England, with an output of nearly 2000 tons of lead concentrate per month. Before the mine reached a prosperous stage it had to pass through many difficulties, but the perseverance of Mr. A. Haselden, the managing director, and those associated with him, has achieved a great triumph. In 1912 the dividends and bonuses amounted to nearly 120%. The main lode strikes east and west in Silurian slate. The average width of solid galena is 9 inches, although variations are frequent. The ore is dressed by hand, the only machinery used being stone-breakers and rolls. The mine is 12 miles from La Carolina, and the company has built a small town, which is excellently managed.

The next in order are the mines on the great Guindo lode. They are the Curas, Culebrina, Guindo, Manzana, Urbana, and Aquisgrana. The Curas and Culebrina are owned by local companies. The former is said to have been started with a capital of £2, and was worked to 1200 ft. in depth. The Culebrina is now down 1000 ft. and still working. The Guindo, Manzana, and Urbana are all between 1000 and 1500 ft. deep, and are operated by the Guindo company, a German-Spanish corporation which makes an output of 2000 tons of concentrate per month. This company made a profit of £120,000 last year. All the mines are equipped with the latest and most up-to-date machinery, which is for the most part electrically driven. The main-shaft hauling-engine is of the Siemens-Ilgner type. The ore is hand-dressed, with motors for driving the rolls and stone-breakers. The present deep levels are rich in lead. Recently I saw considerable stretches of ore having a width of 18 in. solid galena, even more than a metre wide at one place.

About half a mile north of the Guindo mine lies the Sinapismo shaft, and farther west the Rafaelito shaft of the Castillo La Vieja, a French company, with an output of about 1500 tons marketable ore per month. At the Rafaelito a large concentrator has been erected.

The Santa Elena part of La Carolina district is in granite. Several mines have been in operation for many years. The San Fernando lode has six mines, some of which are over 1500 ft. deep. The San Fernando mine was started to exploit a cross-vein, but in depth a 'main' lode was cut. The mine adjoining the San Fernando is called the Ojo Vecino, that is, "look out neighbour." This mine was acquired by a foreign company and deepened to 240 ft. At this depth work was stopped and the concession renounced. It was at once 'denounced' again by a local man and leased to five young energetic officials employed on mines near-by. A hand-winch was rigged into a hoist and the shaft sunk to 300 ft., where ore was struck. Ever since the operators have never had to look back, for they have all made large fortunes.

About 1½ miles farther west are the mines of the Belgian Real Asturiana company. These have been worked to 1500 ft. and are still productive. Latterly a new mine has been started, the Santa Susanna; it is a fairly large producer. To the northwest of Santa Susanna is the Caridad property. Like most mines it has a story to tell. It was denounced by a poor man and leased to a working miner, who made a large fortune. A French company then operated the mine until it reached a poor zone. A year ago a well known local French engineer acquired it, and after a year's anxious work, he has made it a good property. Still farther northwest are several mines owned by Bilbao companies, and some of them are productive.

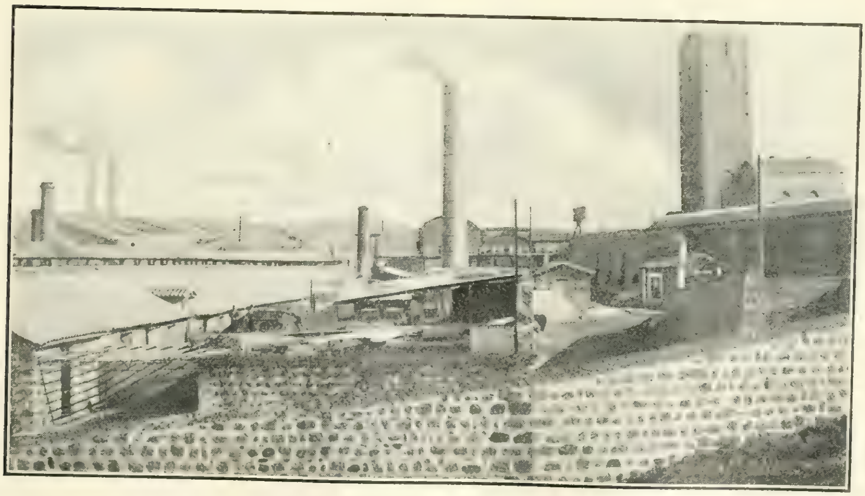
On the Santa Ana mine, situated a mile west of the village of Santa Elena, work was started many years ago, but soon after stopped. It was unfortunate for the owners, because just below the surface the ore was nearly 3 ft. solid. This, of course, was not known then. About two years ago a company at Cartagena took over the property, and under their direction the exploratory work on the 240-ft. level has proved the solid sulphide to be 10 in. wide.

The continuation of La Carolina mining zone to the west is interesting. Twelve miles from El Centenillo—the well known English mine and the largest producer—lies the new district of El Hoyo-San Lorenzo, where the railway from Puertollano to La Carolina will pass. The survey for the railway has been made and tenders have been placed for the construction. The Government guarantees 5%.

At El Hoyo-San Lorenzo 25 lodes are known, most of which show ore near the surface. These are fissure veins and strike similar to those of La Carolina; in fact, the geology is a repetition of the latter district.

Most of the mines are owned by Penarroya, but there is still a good chance for the prospector. This field should shortly come into prominence. It has the advantage over the La Carolina-Santa Elena zone in that the ore-shoots are found near the surface, whereas in La Carolina-Santa Elena it is usually necessary to sink to considerable depth before the galena is cut.

Manzana mine of the Guindo company. Electric plant in foreground.



English lead smelter at Linares.

MINES AND MINERS OF BIBLE TIMES.

Tubal Cain. The Argonauts. Phœnician Exploration. Ophir. Laurium.

By COURTENAY DE KALB.

THE earliest mining engineer of record is Tubal Cain. Lost in the dimness of ancient epochs, when man was groping out of the intellectual darkness of savagery, the human personality of the man is overlaid with the characteristics of a tribal hero. He is called the forger of every cutting instrument of copper and iron, and the father of all workers in those metals. Thus in the very beginning the labour of the miner and metallurgist is associated with the art of war. He is first the maker of weapons for the struggling nations, and then the artificer of luxuries for the conquerors. Throughout history these relationships hold good. In times of national weakness and depression the occupation of the miner has always lagged. His supreme efforts are called forth at periods of organized struggle for aggrandizement, and in the softer days of peace.

Tubal Cain was in no small degree a creature of circumstance. His lot was cast in a wild region where metalliferous deposits abounded, and where wood for his forges was plentiful. He is often mentioned in the Bible, and traces of his fame are legendary today among the rude tribes of north-central Asia Minor. The tribe to which he belonged came to be known as the Tibareni. They inhabited the coast of the Black Sea east of the modern Termé, thence spreading up the great valley of the river Kizil Irmak. It is probable that they originally occupied Cappadocia, farther south in the mountainous interior of Asia Minor, from which they seem to have been driven by the Cimmerians. Tradition points to Cappadocia as the oldest iron and copper producer of the world, although this has not yet been fully confirmed by archæological research. Certain it is that from the southern coast of the Black Sea spread the fame of a race of marvellous metal-workers, whose riches inflamed the minds of the ancients. Ezekiel, in 595 B.C., refers to the Tibareni under the old biblical name, in his prophecy against Tyre, in these words, "Javan, Tubal, and Meshech, they were thy merchants; they traded the persons of men, and vessels of brass, in thy market." On the Assyrian monuments also the sons of Tubal are celebrated under the name of Tabal.

Their skill and their wares, their iron and steel, and copper, and gold, became known to the Greeks during their adventurous exploits in colonization during the eighth century before Christ, which gave rise to the legend of the Argonauts and the Golden Fleece. This ancient fable, in the very names of the actors, is singularly rich in its suggestions of the character, customs, and occupations of the people of this early home of mining.

Nephele, the Cloud Goddess, which may here refer to the clouds of smoke from the forges of Tubal, or of the tribe of the Tibareni, marries Athamas, King of Thessaly. After the birth of their children, Phrixus and Helle, the king deserts Nephele for Ino, a mortal woman. The Cloud Goddess punishes them with a drought, when Ino in revenge starts to sacrifice Phrixus to Zeus. Nephele, in motherly terror, appeals to the ram of the golden fleece to deliver her children. Helle falls into the sea from the back of the ram in its flight, and gives her name to the Hellespont. The ram reaches the kingdom of Æa, in Colchis, meaning 'copper,' safely delivering Phrixus, whose name signifies 'bristling spears.' He is met by the king, Ætes, that is 'the eagle,' who welcomes him, and bestows his daughter Chalciope, 'the maiden of copper,' upon the young man in marriage. The ram is sacrificed at the wedding feast, and the golden fleece is hung upon a bough in the grove of Ares, the god of war, whose son is Eros, the little god of love. It is to capture this golden fleece that Jason sets forth in his fifty-oared ship, the Argo, on that voyage which typifies the everlasting romance of the gold seeker.

To the ancients, however, other deeper meanings were apparent. The ram was none other than a representative of the tribe of Tubal. This name in Hebrew and in Phœnician means 'a ram,' and when it is recalled that Tubal, or Yoval, was a forger of metals it is easy to see what was intended. The hammer of the smith was likened to the head of a ram in its power to deliver tremendous blows. By extension the name was applied also to the ram's horn, which in shape resembled the trumpets fashioned by these workers in copper and bronze, for Tubal is credited with the invention of musical instruments, with which he made joyous sounds. His fame as a musical merrymaker is preserved in our English word jubilee, which is derived from the Latin jubilum, the blast of a trumpet, which in turn comes from this ancient Hebrew name of Yoval (Joval), the father of metallurgy.

Furthermore, in the legend of the Golden Fleece lies hidden the record of an ancient method of the Tibareni, the sons of Tubal, for the collection of gold. The north coast of Asia Minor produced large quantities of the precious metals, as well as copper and iron. Gold was found in the gravel, as often happens still in streams draining from copper regions. The gold in copper ores, originally containing insignificant amounts of the precious metal, accumulates in the course of ages, and sometimes forms placers of astonishing richness. The ancient Tibareni washed the gold-bearing gravel, first by booming, which concentrated the gold into relatively small amounts of sand. This was then collected and washed through sluices having the bottoms lined with sheep-skins. The gold would sink into the wool, while the sand would be washed away in the swift current. The skins were removed from the sluices, the coarser gold shaken out, and the fleeces, still glittering with the yellow metal, were hung upon boughs to dry so that the rest of the gold might be beaten from them and saved. The early Greek mariners, witnessing this process, carried home tales of the wonderful riches of a land where a warlike race of miners hung golden fleeces upon the trees in the grove of Ares.

In those distant times the skill of the miner and metallurgist seemed so marvellous that it was attributed to the black arts of magic, and Greek story relates that a brother of Iobel, or Tubal, named Chrysor, that is, 'the man of the golden wand,' was the discoverer of enchantment and witchcraft, and the legend of the Argonauts perpetuates the notions of occultism in the person of Medea the sorceress, daughter of Ætes, who wreaks revenge upon Jason after successes have turned his head and made him faithless.

The kindred clans of metal workers spread along the shores of the Black Sea toward the East, even to the present district of Kutais, which extends from the mouth of the river Rion to the Caucasus, separating into numerous tribes, one of which became known to the Athenians as the Chalybes, whose name became synonymous in the Greek language with steel, a word which has descended to us as a name for those mineral waters possessing the styptic taste of iron that we call chalybeate.

Enough has been said to show how profound an impression upon the world has been exerted by this master metallurgist whose name first appears in Genesis among the earliest tribal heads of the human race, a son of Japhet, and a brother to Javan, whose tribe also became noted as workers of copper. Their operations were conducted at Mount Alasya in Cyprus, or Κύπρος, from which island the name of cuprum was given to this metal, modified to kaphtor in scripture, and to copper in our English idiom. Tubal possessed those qualities which strangely have inspired the miner and metallurgist ever since. He was a many-sided man, and his people became proficient in many callings—breeders of cattle and sheep, inventors of fishing devices that were the astonishment of the Greeks, makers of wind instruments and harps, even manufacturers of furniture. The famous iron bedstead of Og, the King of Bashan, 1450 B.C., was credited to the crafty metallurgists of this northern hill country of Asia Minor. They also made the ponderous brazen gates of the twenty walled cities of this active and belligerent Og, and even today they are a merry people, full of the glad shout of which Athens heard long ago, and which somehow lingers, as if it were part of the unquenchable spirit of the guild, in the mining camps of the modern world.

Best of all, despite his reputation as a magician, Tubal-Cain was open-minded. The earliest records tell of his readiness to train apprentices. He is called the "instructor of every artificer in brass and iron." He was in a broad sense the honest and genial blacksmith. His first name shows him to be the sinewy forger of metals; the second is the name for the cain-coloured man, he whose beard is the reddish-yellow flame of his forge, Cain, whose name has flowed for ages as a term of honour through the tongues of Asia Minor down to the modern Arabic, for the doer of useful things, the smith!

After so many millenniums the metalliferous country of Tubal-Cain is once more coming into prominence. The natives still cull the high-grade copper ore, and break it into smalls, which they cover with wood and roast to matte; they still work the matte in forge-like furnaces to black copper, which they ship to Alexandretta and to Euxine ports. They still make the famous carbonized iron that was celebrated as Damascus steel because it was distributed through this mart to the rest of the world after receiving a finish by local Damascene workmen. These decadent methods, that give a hint of the approved practice of the father of metallurgy, will soon become wholly extinct, for the modern miner is studying the disseminated copper ores of the Black Sea coast, and threatening to rekindle on a magnificent scale the smouldering fires of Tubal-Cain.

"Tarshish was thy merchant by reason of the multitude of all kind of riches; with silver, iron, tin, and lead, they traded in thy fairs"; so sang Ezekiel in his warning to Tyre. Tarshish was farther from the centres of Ægean and Phœnician civilization in those early days than America was from Europe in the sixteenth century. Jonah, when called upon to perform a distasteful and perilous duty against Nineveh, tells of himself: "But Jonah rose up to flee into Tarshish from the presence of the Lord, and went down to Joppa; and he found a ship going to Tarshish; so he paid the fare thereof, and went down into it, to go with them into Tarshish from the presence of the Lord."

Thus Jonah, as far back as 862 B.C., indulged a notion, still current in these times, that a far off mining country must be a God-forgotten land. There was no place farther from Jehovah's seat to which the prophet could flee.

Modern scholarship identifies Tarshish with Tartessus, the Grecian name for Southern Spain, where the tribes occupying the valley of the Guadalquivir called themselves the Turdetani and Turdali. Herodotus unhesitatingly calls Spain the land of Tarshish. Here are the modern cities of Granada and Sevilla, with the beautiful white Cadiz on the blue Atlantic near the mouth of the river. Though now given over to the quiet occupations of the fruit-grower and the cattle-raiser, these tributary valleys were once the scene of an active scramble for gold. Even on the slopes where now wind the streets of Granada the soil was scarred by the pits of the gold-digger. In the province of Huelva in western Spain the famous copper mines of Rio Tinto, now reckoned among the dominant mining enterprises of our age, were worked in prehistoric times by the Phœnicians, of whose activity traces still remain. Spain is today the second greatest producer of lead and of copper in the world, but from very ancient times to within twenty-five years ago she stood easily first, and her silver mines were scarcely less remarkable. Gold also came from Galicia and Asturias in the north; and from the valley of the Douro and other localities the early miners extracted tin. From Cadiz, Saguntum, and Emporiæ poured the wealth of Spain, one of the most highly mineralized areas of the earth. The ships of Tarshish acquired a reputation like that of the East-Indiamen of later times, vessels built for speed and for resistance to the severest weather. In these great galleys of Tyre, the Phœnicians, refitting at Cadiz, which was as cosmopolitan a port in the past as Hong Kong is in our own epoch, sailed northward to the Cassiterides, the islands of cassiterite or tin-stone, the bleak rocky coast of Cornwall. The source of this greatly coveted metal was guarded as a state secret by the Phœnicians, and on one occasion, when a Roman galley pursued one of the northbound Punic merchantmen, the wily shipmaster ran his vessel into the dangerous shoals of the Scilly Islands to the westward of Land's End, where both pursuer and pursued were wrecked. The record further states that the Phœnician shipmaster, being rescued and escaping back to Tyre, was there rewarded for his fidelity by the gift of another ship from his grateful countrymen. Some of the Cornish tin was passed in barter across Gaul to the port of Massilia, now Marseilles, and thence found its way to the eastern markets, but the far larger quantity undoubtedly came by sea. The antiquity of this commerce is manifested by a sculptured slab recently discovered in Egypt, and deciphered in 1906 by W. Max Müller for the Carnegie Institution at Washington. It is a list of metal-producing countries supplying materials for the splendid temples at Luxor, built by Rameses II. The contributors are represented in long stately procession, tinted in conventional colours used by the Egyptians to represent the different nationalities, and accompanied with animals and other things characteristic of their respective countries. In this heterogeneous caravan marches a file of Phœnicians, bearing each an ingot of tin upon his right shoulder. This marble slab was sculptured at least 1300 years before Christ. In many Egyptian records the commerce in tin with Phœnicia is mentioned. There is no doubt that the Mediterranean peoples also received tin from the mines of Bohemia and Saxony 4000 years ago, and this metal was also known in Babylonia as early as the Assyrian era, which preceded Hammurabi, the great Babylonian lawgiver and friend of Abraham, 2000 B.C. The Assyrian bronzes usually consisted of an alloy of 80% copper and 10% tin. Four centuries earlier alloys of copper with lead, which the ancients were slow in discriminating from tin, containing 78% copper and 18% lead, were known in Mesopotamia, and copper was familiar before the times of Ur-Nina 3000 B.C. It is most significant that the Phœnicians must have been impressed with the Far East as an important source of tin long before its abundance in England had been realized, since this earliest known name for Great Britain, the Cassiterides, is derived from the Sanskrit word for tin, *kastir*, which at once carries the mind to Malay, the centre of the world's present output of that metal.

Communication with the Orient was regularly established by sea from the remotest antiquity. Although costly fabrics, gems, and spices followed the caravan routes to a considerable extent, the evidences of yet more important trade by water are abundant. The voyages seem to have been broken, the ships from India coming to ports on the Gulf of Oman and along the Persian Gulf, attracted by the trade with the opulent cities of the Euphrates. Other ships from the fertile southern region of Arabia, known as Saba, or Sheba, exchanged goods in the ports of the Persian Gulf with East Indian traders. Thus Ezekiel affirmed: "The merchants of Sheba and Ráamah, they were thy merchants: they occupied in thy fairs with, chief of all, spices, and with all precious stones, and gold." Here it becomes apparent that Sheba shipped quantities of spices to Tyre, and these could have come only from India, Ceylon, and Malaya.

Peoples depending upon agriculture seldom display interest in mines, even when brought into mining regions through wars of expansion. The Babylonians never engaged in mining operations save in the most desultory manner. The Egyptians, however, especially under the Memphitic and Rameside dynasties, reached out in search of metals. Rameses II. was a king of unusual mental vigour. Twenty-eight years of incessant struggle in the consolidation of a vast empire had given him a wide outlook upon the world. When peace became established he lived on for 39 fruitful years devoted to the upbuilding of industry and commerce, and to the glorification of his reign by architectural constructions of unsurpassed magnificence. Under such conditions the demand for metals became necessarily large, and Rameses drew heavily upon the mineral resources of the known world. In addition, he scoured his own dominions for copper and gold.

Across the head of the Red Sea was the remarkable Sinaitic peninsula, which had yielded copper, iron, manganese, and turquoise long before the age of Cheops. Rameses systematically developed these deposits, maintaining great communities of slaves as miners in the wadies of Genneh, Maghara, and Nasb, overhung by the lofty precipices of Nubian sandstone. The core of the mountains consists of granitoid rocks, traversed by basic dikes, some of which were accompanied by important veins of copper. Shafts were sunk and adits driven into the mountains, and the ore was carefully sorted to a high grade before smelting. Near the springs in the Wady Nasb are large slag-dumps of the ancient Egyptians, and other slag-heaps occur over a wide area in this region. The mines were fortified against the hostile tribe of the Monitu, and watch towers, and massive walled places of refuge, are scattered over the hills. At intervals caravans would come from Egypt bearing supplies, and taking back the accumulated products of copper, iron, and turquoise. At such times the royal engineers visited the mines, making surveys, and laying out future work. It appears that the mining operations of Egypt were conducted under the guidance of a corps of men specially trained for the service.

Rameses II. also explored the desert country between the Nile and the Red Sea for gold, with apparent success. The mountains of Edbo (modern Edfu) and Koptos yielded gold "in hundred thousands and in great masses," according to the royal records. Gold mines were also worked by shafts at Akita in the Wady Ollagi, and at Eshuránib. One of these shafts attained a depth of 180 feet. These mines were abandoned for want of water, but they were not forgotten, and Rameses III., the grandson of Rameses the Great, after quelling revolutions that marred the early years of his reign, is said to have gone in person, wearing his royal symbol, the gnu's tail, hanging from his belt behind, and to have directed the deepening of the ancient well. By good luck he speedily found water, and the mine flourished. The quartz was painfully chiselled-out, broken small with hammers, further disintegrated and softened by heating, followed by quenching with water, and then ground in granite mills like corn.

The crushed ore was washed on inclined slabs of rock, like the Mexican *planilla*, to separate the gold. Rameses likewise exploited mines in Koshi, the Egyptian name for Nubia, and he brought enormous quantities from Amau, which is one of the ancient names for Somali Land, the Punt or Put of the Bible record.

In addition to these few noteworthy efforts in mining it must be remembered that the curiosity of man on discovering heavy minerals awakened his inventive spirit as a metallurgist in widely separated localities. The brilliancy of the Mountain of Malachite in the Sinaitic peninsula was a sufficient incentive to cause even the rude nomads to begin the mining and smelting of copper, which later was pursued so energetically by the Egyptians. The mines of southern Germany were worked in ages long precedent to the development of Grecian civilization. The Nubians discovered beds of hematite and became skilful smiths as early as the Fourth Dynasty in Egypt, 4000 B.C. The Ægean Islands were producers of gold, silver, and copper, and the Etruscans independently developed the art of mining, stimulated by the varied metalliferous deposits of Italy.

The silver mines of Laurium in Greece were operated in the time of Solon, contemporary with the Babylonian captivity of the Jews. The development of these famous deposits was as opportune for Greece as was the sudden unfolding of the wealth of the Comstock mines in Nevada for the finances of the United States. The revenue from Laurium was not only helpful to Solon in his schemes for reform at a critical period, but it came to the aid of Themistocles in 483 B.C. The discovery of new bodies of rich ore at that time led to a popular demand for the distribution of this unexpected wealth among the citizens of Athens. Themistocles, however, with wise foresight, persuaded the people to permit his use of the silver in strengthening the navy for defence against the foes of the republic. Still later these mines served Nicias, a rude but forceful demagogue, in carrying out his plans in popular government, and finally, in 355 B.C., Xenophon was instrumental in having them sold by the State to private companies, resulting in energetic exploitation which added greatly to the wealth of the country at large. Like so many of the wonderful mines discovered by the ancients, Laurium still figures as a large producer, a thousand tons of ore per diem being treated in a modern plant by a French syndicate on the spot that has witnessed almost continuous mining and metallurgical operations for more than 2500 years.

Of all the mining and metallurgical labours of antiquity, none has appealed more largely to the imagination of men through subsequent centuries than those conducted under the auspices of Solomon. Monarchs ambitious for magnificent architectural display have necessarily been patrons of mining. The expression of Solomon's taste was less in massive construction than in refinement of form and in elaborateness of decoration. He sought the costliest woods, and then covered them with gold plate and gilding. The glitter of gold, of copper, and of bronze, pervaded every detail of the splendid temple and the sumptuous palace that he erected. This was not work that could be done by commanding an army of slaves after the fashion in Egypt. It required the resources of vast wealth in material things. His own country possessed no mines. Even his timber had to be brought from the territory of Hiram, the great king of Phœnicia. He was obliged to send abroad for skilled workmen. He had to import quantities of copper and tin, huge for those days of clumsy transport. He had to call upon foreign glassmakers to devise his crystal palace, which so deceived the Queen of Sheba that she lifted her skirts as she entered, mistaking the luminous floor for a pool of limpid water. It was impossible to obtain the funds for his luxurious temples, and palaces, and gardens, for his gilded Egyptian chariots, and his richly caparisoned horses, merely by taxing a nation of farmers and herdsmen. To gratify his tastes he was forced to become an adventurous speculator. With Jewish shrewdness he combined his resources with those of his kingly neighbour Hiram in expeditions to the mines of Tarshish, Punt, and Ophir. Thus he augmented his wealth, and the riches obtained by these fortunate ventures under this commercial partnership of monarchs doubtless had much to do with the submission of Hiram to some of the sharp practices which Solomon displayed in his dealings. There was a sufficient commercial reason for Hiram's seeming indifference to the trick of paying some of the balance due upon cedar and fir trees by a gift of twenty Galilean cities. Hiram came up to see the cities which Solomon had given him, and "they pleased him not." He called them dirty cities, and contemptuously gave them back, but it is noteworthy that he did not demand the return of the gold he had sent to Solomon. The great king of Jerusalem had conceived and opened new possibilities of foreign trade to Hiram. One great voyage is specially celebrated. Solomon provided funds and servants for outfitting an expedition to Ophir, while Hiram built the ships and supplied trained seamen. The fleet was equipped at Ezion Geber at the head of the Gulf of Akabah, the eastern arm of the upper portion of the Red Sea. Thence they sailed on a three years' cruise, bringing gems, spices, peacocks, apes, sandalwood, and, above all, gold. The product of this single voyage is said to have amounted to 420 talents of the precious metal, a sum equal to £2,740,000. From all these sources of gold upon which Solomon drew, western, southern, and eastern, his revenue in this metal is stated to have been 666 talents yearly, or £4,350,000, a sum nearly equal to the revenue derived by Ptolemy II. from his famous mines of Um-Rus and Berenice, between the Nile and the Red Sea. It is quite certain that Hiram profited equally by this adventurous commerce, and was unwilling to pick a quarrel with his clever neighbour.

The site of Ophir has been a subject of almost acrimonious debate among scholars, and absolute proof is still wanting. It is mentioned in the Bible as a place so well known as to require no explanation. It was in keeping with the policy of Solomon to reach into countries where no uncertainties of success might defeat the commercial ends of his expeditions. No evidence exists to show that he undertook exploration, or that his servants discovered new sources of riches. Neither is evidence given that he maintained regular communication with distant mining regions, which would have been necessary had he been operating mines in the same manner as the Egyptians in Arabia, the Bisháree desert, and Somali Land. The gold of Ophir was readily obtained from a recognized source of that metal. This eliminates fanciful expeditions into the interior of Africa. The ingenious argument of Carl Peters from the etymology of the name Africa, which comes from the Arabian 'Afir,' the Land of the South, is met by the equally plausible argument that the region extending from the head of the Persian Gulf northward to Susa, the Shushan of the Bible, near the modern Dizful, was known as Apir, and is frequently referred to by the Elamites as late as the eighth century before Christ. This was one of the most noted gold countries in ancient times, the fame of which has come down to us through the writings of Diodorus, Strabo, Pliny, and others, who call the gold of this coast 'apyron,' that is, unrefined by fire, indicating that its fineness was such as not to require purification. Considering the distance from Ezion Geber, the littoral currents to be overcome, and the monsoons to be avoided, it is estimated that this voyage would occupy a fleet of ships of the Tarshish class just about three years. It would have been impossible in that length of time to have gone as far as India, and still less possible to have journeyed as far as the Malay Peninsula. The country of Abhira, east of the Indus, to which gold was brought from Kashmir, and the mountain called Ophir near Jahore, may have indirectly contributed part of the gold which was brought back by Solomon's fleet. The immense stores of gold, and the rare products of India, with which the Queen of Sheba had enriched her kingdom at the fertile southern extremity of Arabia, were certainly the fruit of advantageous barter, and it is no less probable that Solomon likewise traded for gold, for peacocks, for spices, sandalwood, and gems, with mariners sailing from the Far East to the marts of the Persian Gulf.

It must not be overlooked that among other sources of gold, Havilah, Parvaim, and Uphaz, in central and eastern Arabia, are mentioned in the chronicles of the Solomonic period as being in the vicinity of Ophir. The identification of this famous place of gold with Uppara in the land of Apir, near the head of the Persian Gulf, is confirmed by a mass of evidence which practically eliminates every other suggested locality.

Punt also may have swelled the treasure of King Solomon. It was "the divine country" of the Egyptians, the Somali Land of our own day, and had tributary to it the riches of Abyssinia. Lying on the Gulf of Aden, directly opposite the kingdom of Sheba, it was easy of access to the maritime traders of Solomon and Hiram. It was a country where the kingly merchants of Egypt, from the fifth dynasty and earlier, resorted for gold, and ivory, and ebony. Seneferu, of the third dynasty, was such a royal merchant, risking the wares of Egypt on adventurous expeditions to Syria, to Punt, and to Nubia; while Sahura, of the same line of priestly monarchs, brought back from Punt on a single voyage 80,000 measures of myrrh, and 6000 pounds of electrum, an alloy of gold and silver. The Elephantine barons, those war-lords who guarded the southern entrance into Egypt, ranged far into Abyssinia, Somali Land, and even into Uganda, and on one occasion it is recorded that they were also sending pigmies whom they had captured in the heart of Africa. Their letters, forwarded in advance, aroused the interest of the boy-king Pepi II, only eight years of age, who wrote in childish delight to these wild barons of the south, expressing his joy over such rare playthings as live pigmies from the land of gold and ivory.

Many of the difficulties of interpreting the accumulations of gold and other metals by powerful monarchs in the hazy dawn of history disappear as soon as the conception is grasped that these great kings were not mere human tigers thirsting for bloody conquest, but that they regarded the expansion of commercial relations as one of the great aims of their warlike enterprises. It was in part to clear the way of hostile assault upon their routes of trade that they seized the lands of nations which chanced to occupy strategic positions. The booty captured was a poor return for costly foreign wars, while the trader's profit upon the manufactures coveted by the miners on the far-off fringe of the civilized world would yield to a single peaceful expedition of a few hundred men greater riches to gratify the luxurious tastes of a monarch than could be hoped for from a campaign with half a million soldiers. The pomp and glory of conquest were well enough for inspiring dread abroad, and for humbling the people at home to respectful obedience, but above all this the monarch must be a task-master, with slave-drivers, to turn out the goods that he could exchange for gold and silver, for tin, and copper, and steel, from foreign countries.

It was the merchant Queen of Sheba, who probably did not possess a single mine of her own, who could enter the Holy City with a mighty caravan of camels and asses gleaming in silken coverings of purple and green, overwrought with embroideries of gold and silver, and set with precious stones, stretching in gorgeous splendour from Zion's Gate into the Valley of Kidron. It was this merchant Queen who could offer to Solomon, as if it were a bauble, the princely gift of £800,000 worth of golden ingots. These were days when the warfare of nations and the warfare of commerce were one; when the kings were millionaires and the millionaires were kings.

They exalted the clever workman; they used the incentive of power and honour to encourage skill. The artificers of Egypt, of Babylonia, of Phœnicia, of the Ægean Islands, were great men. Just as England decks her greatest physicist with the title of Lord Kelvin, and exalts her chief iron-worker to the rank of Sir Henry Bessemer, so the master craftsmen of the past became over-lords with reputations that made them desired and sought after by the greatest kings. Mertisen, the chief artist to King Mentuhotep of Egypt, was one of these; and Sen-Mut, who became prime minister to Queen Hatshepsut, the woman who put on a beard and insisted upon being spoken of as "His Majesty," was another of these exalted engineers, equally distinguished as metallurgist, architect, and statesman. Still another was Huram of Tyre, who was permitted by King Hiram to assume charge of King Solomon's work of building the royal palace and the Temple at Jerusalem. He was the son of a famous Tyrian metallurgist, of Israelitish extraction from the stock of Ur, while his mother was of the tribe of Naphtali. The story of his accomplishments is told in Kings I., where he is represented as far more than a mere founder of metals. Even in the critical kingdom of Solomon this Huram is acknowledged to have been filled with wisdom and understanding as well as with "cunning to work all works in brass." He was a master of all the crafts connected with architecture and decoration, "Skilful to work in gold, and in silver, in brass, in iron, in stone, and in timber, in purple, in blue, and in fine linen . . . . , also to grave any manner of graving, and to find out every device which shall be put to him, with thy cunning men, and with the cunning men of my lord David thy father" (Chron. II., 2, 14). He was a cultured man, of broad training, true to the high traditions of a profession that is equally exacting of its devotees today. The great solid brass pillars, 27 feet high, the pots and basins, the massive chains, the checker-work, the chapiters wrought in the form of lilies, the bells and the pomegranates, the fitted stones and timbers which all went together without the sound of a tool being heard in the temple while it was building, and above all the wonderful brazen pool called the 'molten sea,' a great bowl 15 feet in diameter, with walls four inches thick, swelling outward at the brim in the shape of a thousand lilies seeming to float upon a thousand little pools of water, the whole resting upon the backs of twelve brazen oxen with lowered heads facing outward in all directions, with further complications of multiple bases, of lions, and cherubims, and lavers, all these were the products of a brain that comprehended many arts and many sciences, and along with it possessed the faculty of controlling men and of assembling the products of many hands engaged in working out minutely executed designs. The mere metallurgical problem of making a homogeneous casting of so great a basin of brass would tax the skill of our ablest bellfounders today. Huram went down into the low ground below Jerusalem in the plain of Jordan between Succoth and Zarthan to cast them. There he had available the sandy loam known as moulder's clay, suitable for such work, and when these objects had been finished they were so massive that Solomon was unprepared to weigh them, and had to settle on Huram's estimate of the quantity of metal consumed.

Operations such as these cannot be called primitive. Choice furniture, and carriages, and *bric-a-brac*, such as were found in the tomb of the noble Queen Tyi at Tel-el-Amarna in Egypt, were not the products of untrained men merely clever in doing a few things by rule of thumb. The metallurgists and plumbers who not only wrought decorations, but installed bathtubs, and drains with siphon-traps, in King Minos' palace in Crete, such as would pass a twentieth century sanitary inspection in New York or London, were not children in the arts and crafts. The resources and abilities of the miner and metallurgist are a measure of civilization, and one marvel of the ancient world is that it seems so modern when gauged by this standard. The habits of thought that go with the industrial status of each age make the past seem new and the new seem old. The worker who contributes to the power and luxury of men claims toll of the times in which he lives, while the wealth that springs from his search and his skill is gathered as an emblem of greatness about the mighty, to dazzle the world and to win homage. It may all be stated in terms of the royal metals, as said Isaiah: "They lavish gold out of the bag, and weigh silver in the balance, and hire a goldsmith; and he maketh it a god; they fall down, yea, they worship."

The South Australian government has offered a bonus of £5000 to the first person obtaining from a bore or well in the state 100,000 gallons of crude petroleum containing not less than 90% of products obtainable by distillation. An applicant for the bonus must present a monthly record of work done, a full log of all bores, whether successful or otherwise, samples of materials brought up by the bores, taken at every 50 ft. sunk and at each change of stratum, and a declaration of the exact locality of each bore. The oil must have been stored at the bore from which it has been obtained until the whole of the 100,000 gal. has accumulated.

Mineral Production of Canada.

The preliminary report for 1913 on the mineral production of Canada, prepared by Mr. John McLeish, gives the following table of figures:

	1912. Quantity.	1913. Quantity.
Copper ....Lb.	77,832,127	76,975,832
Gold ....Oz.	611,885	784,525
Pig iron ......*Tons.	1,014,587	1,128,967
Lead...............Lb.	35,763,476	37,662,703
Nickel .... „	44,841,542	49,676,772
Silver ....Oz.	31,955,560	31,750,618
Less pig iron credited to imported ores Tons.	978,232	1,055,459
Asbestos and Asbestic ....Tons.	136,301	161,086
Coal .... „	14,512,829	15,115,089
Gypsum ....„	578,458	639,698
Natural gas ...M. ft.	15,286,803	20,345,763
Petroleum ....Bbl.	243,336	228,080
Salt ....Tons.	95,053	100,791
Cement ....Bbl.	7,132,732	8,658,922
Lime ....Bushels.	8,475,839	7,671,381

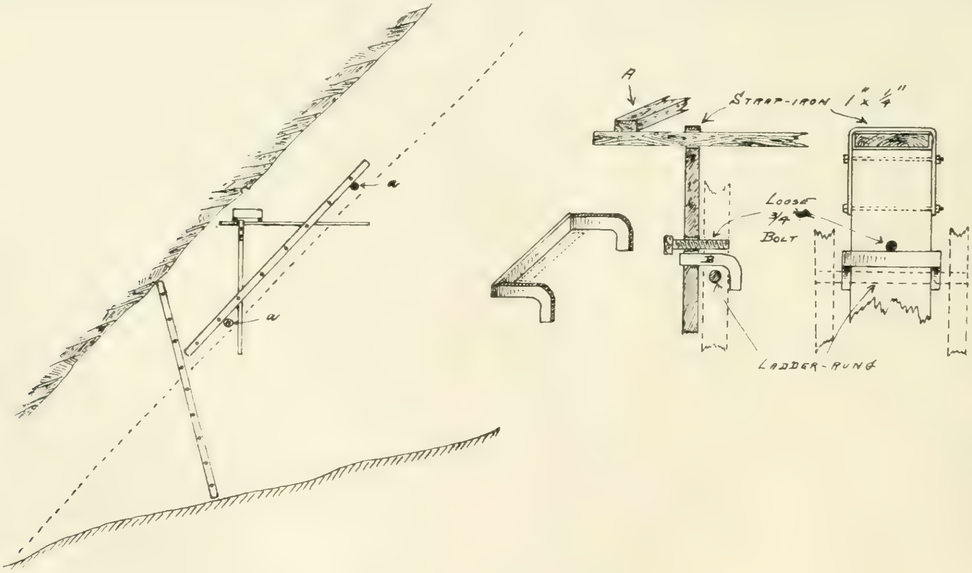
*Short tons throughout.

The total value of the production during 1913 was $144,031,047, as compared with $135,048,296 in 1912. The variation in the figures for copper, lead, silver, and iron do not call for special mention, but the advance in the yield of gold and nickel is noteable. As regards gold, the production was worth $16,216,131, an increase on that of 1912 of $3,567,337. The chief increase was due to the Porcupine district of Ontario, but Mr. McLeish does not quote the exact figures. The production in the Yukon was $5,835,554 as against $5,576,493 in 1912, and in British Columbia $6,136,900. The output of nickel rose from 44,841,542 lb. to 49,676,772 lb. The output of silver was 31,750,618 oz., a fall of 204,942 oz. on the year. Of the amount 29,514,397 oz. came from Cobalt. Of pig iron, 1,128,967 short tons was produced as compared with 1,014,587 tons in 1912. By provinces, the figures were 480,068 tons from Nova Scotia, and 648,899 tons from Ontario. In addition, there was produced by the electric furnace 8,075 tons of ferro-phosphorus, ferro-silicon, and ferro-manganese. The coal production of British Columbia declined from 3,208,997 tons to 2,714,449 tons, but on the other hand the output of Nova Scotia and Alberta showed advances. The Nova Scotia figures were 7,972,727 tons as compared with 7,783,888 tons, and those of Alberta 4,144,377 tons as compared with 3,240,577 tons.

AIDS TO THE ENGINEER.

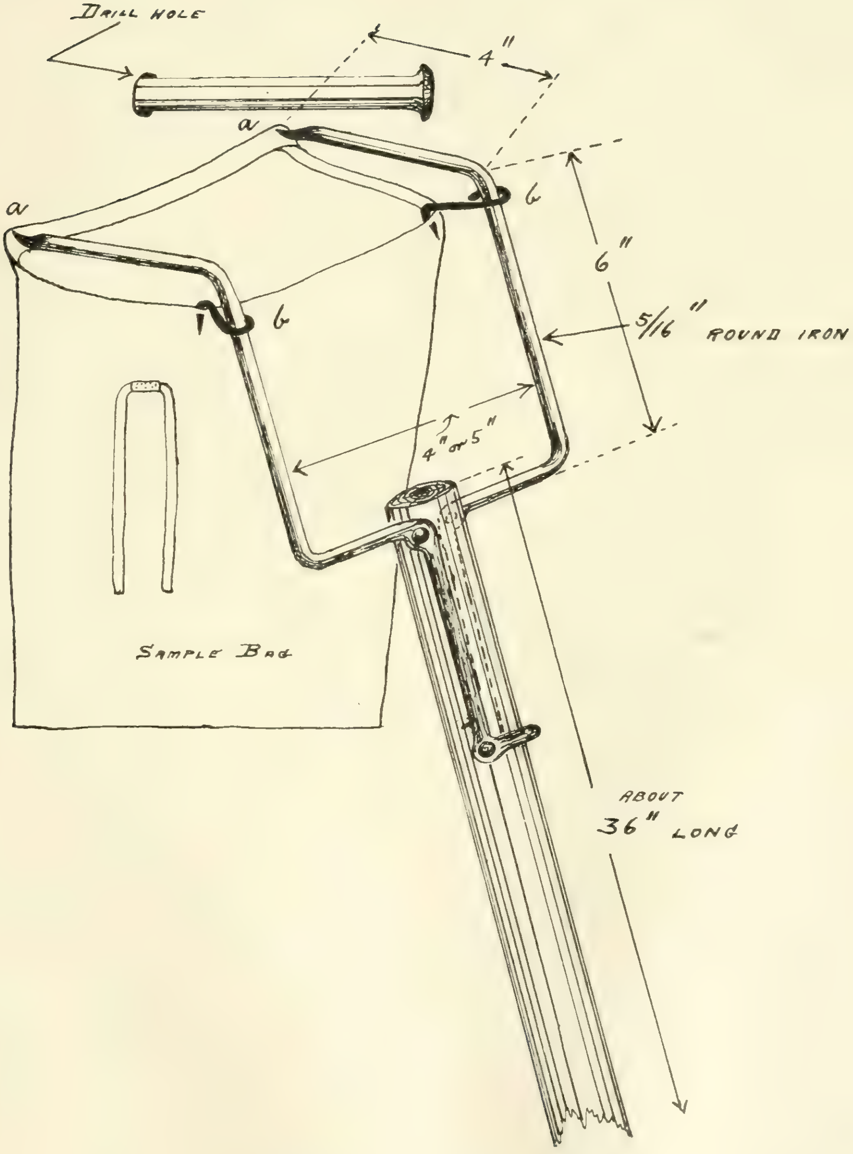
By A. LIVINGSTONE OKE.

Sampling Stopes.—In many parts of South America, it is common to find that the old workings or *antiguas* have been left in the shape shown in the sketch, due to the fact that the original method of development was by means of an inclined shaft or *chiflon*, and subsequent stoping has been done in the floor, gradually lowering it, until the roof of the inclined shaft is out of reach of the longest available ladder. In lodes that are nearly vertical it is particularly difficult to reach these 'backs,' for sampling, and the sketch shows one arrangement for rigging, in places like that shown. If light ladders are available, holes may be drilled at *aa* and a ladder placed on ⅞in. drill-steel, left in these holes, but the safest plan is to cut hitches and put in light stulls, if the width of the working is not too great. The ladders being placed approximately parallel to the roof, two light planks can then be utilized, as shown, in order to allow the sampler to reach the 'back,' to cut the sample. The vertical plank passes through a flat iron hook *B*, hung on the stave vertically underneath the proposed position of the sample; this plank has 1-in. holes drilled along its centre to take a loose ¾-in. bolt, and is adjustable as to height. On the top of the vertical plank is a strap-iron through which passes the horizontal plank; the back end of this plank also has holes drilled in it, for inserting a loose bolt to prevent it sliding over the top of the ladder-rung. At the front end of the top plank light cross-pieces of timber *A* may be nailed temporarily, to steady the whole, when the sampler is sitting astride the plank, with the sample-box in front of him. This method of rigging more particularly applies to vertical lodes, as is obvious, but the same two planks, arranged with the iron-straps, etc., will be found useful in connection with work, on ladders, in other directions.



SAMPLING AWKWARD STOPES.

Bag-Holder for Drill-Hole Sampling.—In the course of sampling underground, it is often desirable to test the walls on either side of workings on the lode, to ascertain if there is any ore beyond the actual width exposed. The usual method of doing this, where a cross-cut is not necessary, is by drilling horizontal holes and saving the material for assay. In the sketch is shown a simple appliance that I have found useful for catching the drillings in a bag, so preventing any loss of the same, from the carelessness of the man doing the work. It consists of a two-pronged fork of stout iron wire, attached to a



BAG-HOLDER FOR DRILL-HOLE SAMPLING.

handle, the lower end of which rests on the floor. The two prongs at *aa* are set at the top edge of the bag and rest against the wall, centrally underneath the drill-hole. At *bb* are two small sliding hooks which can be used to keep the bag fully open, so that all the drillings scraped from the bore-hole fall directly into the bag. This fork rests against the wall on its two prongs while the third point is on the floor, thus ensuring a perfectly steady three-point support.

Surveyor's Tape-Grip.—The diagram illustrates a little device that was made by me a few years ago, to be able to fix a clamp on a surveying-tape at any point in its length, in order to facilitate the stretching of it between plumb-lines when measuring. With the long steel tapes now commonly used it is often difficult to get a proper hold, when the distance measured is less than the length of the tape, and sometimes it is necessary to take a half-turn round the arm to obtain the requisite grip. The device consists of a steel or brass sleeve with an opening at one side, *A*. Through this opening the tape is inserted and the wedge-shaped piece pushed in and tightened. The usual handle supplied with the tape is attached to the wedge; and the more the tension, the more it grips the tape. A slight knock on the thin end of the wedge immediately frees the tape. It will be seen that by making the bottom of the wedge with a V-shaped groove it is equally applicable for use as a wire-grip. The principle is the same as that of the Rubble wire-rope clamp, but the writer was using one of these several years before this clamp was described in the technical press.

Filing Drawings.—The sketches illustrate a convenient method of filing drawings in an office. It consists of a frame-work *E*, hinged at *D*, and nailed to the wall of the office. The width of the frame depends on the size of the largest plan that it is necessary to handle. The length outward from the wall may be three or four feet, if there are a large number of drawings to be filed.

The slots shown in the ends of the frame are designed to receive the pins on the ends of the light slats shown at *B*, from which the plans are suspended. The plans may be fastened to the slats by gumming on or by some method of pinning or clip, as desired. At *A* is shown a flat hook made of tin-foil with a paper clip in it and these may be fastened to the plan, to the number required and then hung to a stiff wire, across the frame. At *C* is shown a piece of canvas or oil-cloth fastened to the plan by paper clips, the wire to support it passing through. When not in use the plans are swung against the wall by means of a light cord passing over a pulley in the ceiling, so that they lie flat and occupy no more room than in a drawer. The slots in the frame should be made with a slight cant toward the hinge, as shown.

At the upper end of the frame is shown a roll of oil-cloth, which may be let down when the frame is swung up and acts as a dust-screen and also prevents the fading caused by exposure to light.

Bolivian Weights and Taxes.

In an article in the *Mining and Scientific Press* on the 'Transportation and Government Regulations in the Bolivian Tinfields,' G. W. Wepfer gives tables for converting Bolivian weights and for estimating the export duty on tin concentrate and tin bars.

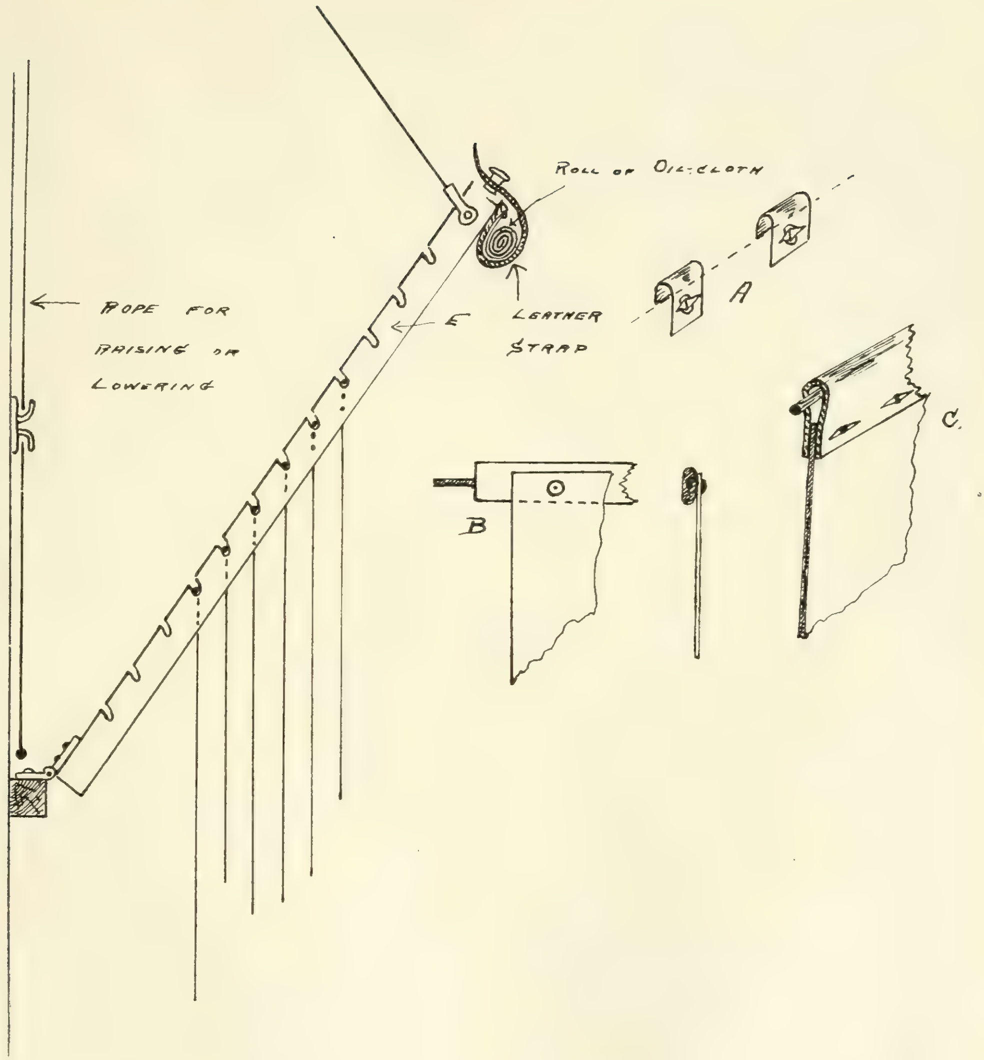
Weights.—All the South American countries have adopted the metric system, but in practice they use mostly the old Spanish system. The following conversion table shows the relation between the old Spanish units and the present standards:

1 metric ton = 10 metric quintals = 21·734 Spanish quintals.
1 Spanish ton = 20 Spanish quintals = 920·80 kilos = 2000 libras.
1 English ton = 1015·938 kilos = 2240 lb. English = 20 cwt. of 112 lb
1 metric quintal = 100 kilos = 220·47 lb. English.
1 Spanish quintal = 46 kilos = 101·4116 lb. English.
1 English quintal = 50·7969 kilos = 112 lb. English.
1 cajon = 50 Spanish quintals = 50 × 101·4 = 5050 lb. English.
1 marco 0·507058 lb. avoirdupois (say = ½ lb. English).

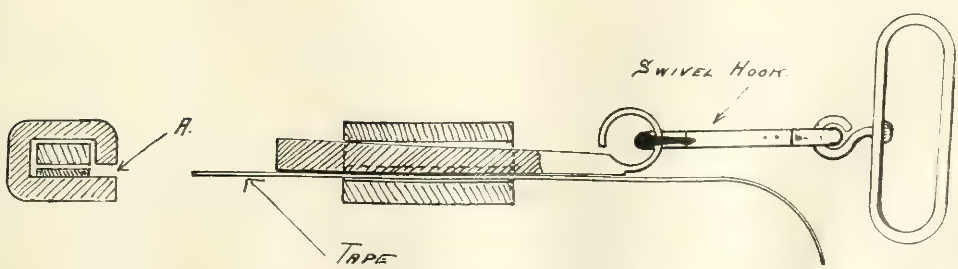
Export Duties.—Based upon the price of Straits tin, which is obtained every two weeks from London, the corresponding duty remains unchangeable for two weeks:

Price of Straits tin in £ per ton.	Concentrates. Duty per 100 kg. $	Bs.*	Tin bars. Duty per 100 kg. $	Bs.*
Up to 100	0·80	2·00	1·30	3·25
100 to 110	0·88	2·20	1·40	3·50
110 to 120	1·14	2·85	1·75	4·37
120 to 130	1·40	3·50	2·10	5·24
130 to 140	1·66	4·15	2·45	6·11
140 to 150	1·92	4·80	2·79	6·98
150 to 160	2·18	5·45	3·15	7·87
160 to 170	2·44	6·10	3·50	8·74
170 to 180	2·70	6·75	3·85	9·61
180 to 190	2·96	7·40	4·20	10·48
190 to 200	3·22	8·05	4·54	11·35
200 to 210	3·48	8·70	4·90	12·22
210 to 220	3·74	9·35	4·24	13·09
220 to 230	4·00	10·00	5·58	13·96
230 to 240	4·26	10·65	5·94	14·85
240 to 250	4·52	11·30	6·28	15·70

* In this table the value of the Boliviano is taken at $0·40 gold



Arrangement for filing Drawings.



Surveyor's Tape Grip.

QUOTATIONS

of leading mining shares on the London Market.
Shares are £1 par value except where otherwise noted.
Quotations are given in shillings.

GOLD, SILVER, DIAMONDS:	May 1 1913	April 1 1914	May 1 1914
RAND:			
Bantjes	22	14	14
Brakpan	80	46	45
Central Mining (£12)	207	155	178
Cinderella	12	6	6
City & Suburban (£4)	50	48	48
City Deep	71	60	65
Consolidated Gold Fields	56	45	46
Consolidated Langlaagte	28	31	32
Consolidated Main Reef	21	18	17
Crown Mines (10s.)	151	120	122
Durban Roodepoort	20	17	21
D. Roodepoort Deep	25	17	16
East Rand Proprietary	56	37	35
Ferreira Deep	68	47	50
Geduld	23	24	23
Geldenhuis Deep	33	22	23
Heriot	75	52	60
Jupiter	10	5	5
Kleinfontein	22	24	23
Knight Central	13	10	9
Knight's Deep	45	31	35
Langlaagte Estates	26	18	18
Luipaard's Vlei	9	9	10
Main Reef West	15	7	7
Meyer & Charlton	110	105	108
Modderfontein B	79	78	82
Modderfontein, New (£4)	262	240	248
Nourse	38	31	30
Primrose	32	26	22
Rand Mines (5s.)	139	115	120
Randfontein Central	28	20	20
Robinson (£5)	67	53	55
Robinson Deep	42	27	28
Rose Deep	60	45	43
Simmer & Jack	14	10	10
Simmer Deep	4	2	2
Springs	16	13	13
Van Ryn	76	66	66
Van Ryn Deep	29	42	46
Village Deep	43	35	38
Village Main Reef	42	32	35
Witwatersrand (Knight's)	68	66	70
Witwatersrand Deep	57	51	53
Wolhuter	17	15	16
RHODESIA:			
Cam & Motor	36	25	25
Chartered	22	19	18
Eileen Alannah	13	12	11
Eldorado	21	17	17
Enterprise	13	11	11
Falcon	24	12	13
Giant	19	16	14
Globe & Phœnix (5s.)	28	35	34
Lonely Reef	57	32	31
Shamva	58	41	42
Wanderer (5s.)	3	2	3
Willoughby's (10s.)	11	8	8
OTHERS IN SOUTH AFRICA:			
De Beers (£2 10s.)	417	373	335
Glynn's Lydenburg	20	10	10
Jagersfontein	140	93	85
Premier Diamond (2s. 6d.)	235	177	157
Sheba (5s.)	5	5	5
Transvaal Gold Mining Estates	57	42	41
WEST AFRICA:			
Abbontiakoon (10s.)	7	7	6
Abosso	18	16	16
Ashanti (4s.)	21	16	15
Broomassie (10s.)	7	5	4
Prestea Block A	16	12	12
Taquah	18	16	15
WEST AUSTRALIA:			
Associated Gold Mines	7	8	7
Associated Northern Blocks	19	7	7
Bullfinch	16	7	7
Golden Horse-Shoe (£5)	52	51	46
Great Boulder Proprietary (2s.)	11	14	14
Great Boulder Perseverance	3	2	2
Great Fingall	8	10	8
Ivanhoe (£5)	65	55	52
Kalgurli	40	37	35
Sons of Gwalia	22	23	25
Yuanmi	10	4	4
OTHERS IN AUSTRALASIA:			
Blackwater	21	17	17
Consolidated Gold Fields of N.Z.	14	17	15
Mount Boppy	17	13	12
Mount Morgan	71	62	52
Progress	6	12	13
Talisman	37	40	37
Tasmania Gold (10s.)	1	½	½
Waihi	31	45	43
Waihi Grand Junction	17	25	27
AMERICA:			
Alaska Treadwell (£5)	175	165	162
Buena Tierra	20	15	15
Butters Salvador	50	22	22
Camp Bird	18	12	11
Casey Cobalt	55	20	17
Cobalt Town Site	68	41	42
El Oro	15	14	12
Esperanza	26	17	16
Granville	13	10	10
Mexico Mines of El Oro	112	102	87
Oroville Dredging	7	13	11
St. John del Rey	17	16	16
Santa Gertrudis	26	15	13
Stratton's Independence (2s. 6d.)	2	½	½
Tomboy	26	22	21
RUSSIA:			
Lena Goldfields	55	37	40
Orsk Priority	15	7	7
Siberian Proprietary	7	6	3
INDIA:			
Champion Reef (2s. 6d.)	11	10	10
Mysore (10s.)	105	96	92
Nundydroog (10s.)	25	25	25
Ooregum (10s.)	20	23	22

COPPER:

	May 1 1913	April 1 1914	May 1 1914
Anaconda (£5)	150	148	135
Arizona (5s.)	37	38	38
Cape Copper (£2)	127	72	67
Chillagoe (10s.)	1	½	½
Cordoba (5s.)	6	6	6
Great Cobar (£5)	45	6	3
Great Fitzroy (5s.)	1	1	1
Hampden Cloncurry	42	32	30
Kyshtim	63	56	60
Messina (5s.)	23	31	31
Mount Elliott (£5)	105	73	66
Mount Lyell	25	26	25
Rio Tinto (£5)	1560	1440	1432
Sissert	25	27	28
South American Copper (2s.)	35	33	32
Spassky	78	56	56
Tanalyk	47	65	80
Tanganyika	47	41	39
Tharsis (£2)	151	140	140
Whim Well	21	7	5

LEAD-ZINC:

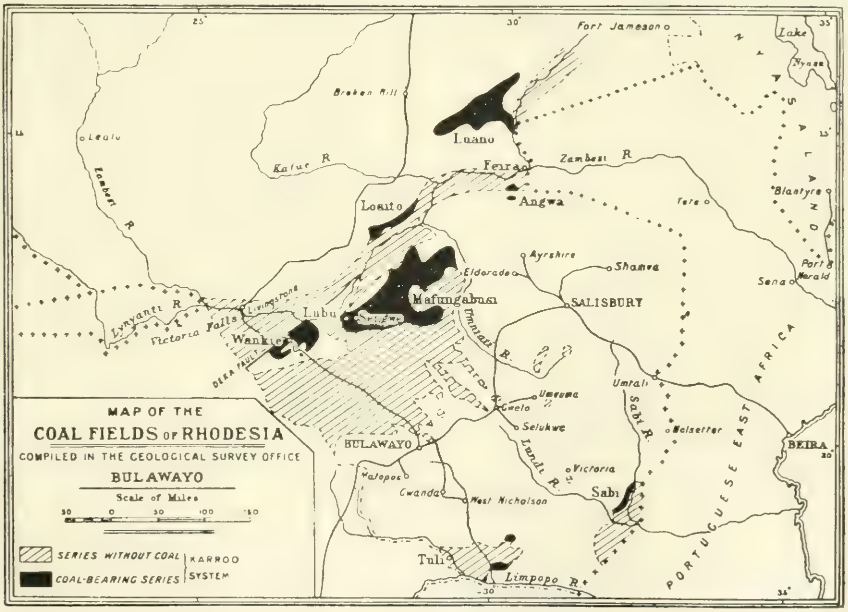
	May 1 1913	April 1 1914	May 1 1914
BROKEN HILL:			
Amalgamated Zinc	35	28	29
British Broken Hill	37	41	40
Broken Hill Proprietary (8s.)	37	37	39
Broken Hill Block 10 (£10)	31	36	35
Broken Hill Block 14 (25s.)	8	7	7
Broken Hill North	47	53	54
Broken Hill South	150	173	175
Sulphide Corporation (15s.)	26	25	25
Zinc Corporation (10s.)	17	21	20
RUSSIA:			
Russian Mining	8	35	43
Russo-Asiatic	—	145	186

TIN:

	May 1 1913	April 1 1914	May 1 1914
NIGERIA:			
Abu (5s.)	—	8	6
Bisichi	23	15	14
Jos (5s.)	9	7	6
Kaduna (5s.)	27	17	17
Naraguta	37	28	28
Nigerian Tin	28	17	15
N. Nigeria Bauchi (10s.)	6	5	4
Rayfield	21	8	9
Ropp	156	136	120
OTHER COUNTRIES:			
Aramayo Francke	32	36	35
Briseis	11	6	6
Cornwall Tailings	30	17	20
Dolcoath	19	13	11
Geevor (10s.)	16	7	7
Gopeng	31	32	30
Mawchi	23	25	25
Pahang Consolidated (5s.)	9	11	9
Renong Dredging	—	66	52
Rooiberg	36	25	25
Tekka	72	60	57
Tronoh	78	36	32

PRECIS OF TECHNOLOGY

Rhodesian Coal Resources.—Bulletin No. 4 of the Rhodesian Geological Survey contains chapters on the coal resources of Rhodesia, by H. B. Maufe, the geology of the Wankie coalfield, by B. Lightfoot, and on the Wankie colliery, by A. R. Thomson. The coal-bearing beds of Rhodesia belong to the Karroo formation, which is widely distributed in the low-lying basins of the Limpopo and Zambesi rivers and their affluents. The largest area of Karroo rocks occupies the middle course of the Zambesi, and stretches southward toward the Zambesi-Limpopo watershed. Within this area are the Wankie, Lubu, Sengwe, and Mafungabusi coalfields; and on its northeastern extension down the Zambesi valley is the Angwa coalfield. North of the last-named is the Luano coalfield in Northern Rhodesia. To the south of the Limpopo river are the three small coalfields of Umsingwani, Singwesi, and Massabi, in the Tuli district, and to the southeast is the Sabi coalfield. The accompanying map shows the coalfields in solid black, and the rest of the Karroo beds in hatching. In most districts the Karroo beds rest in great discordance upon the granites and schists belonging to the ancient metamorphic system. In one or two districts there are intervening grits and hard shales, that have been correlated by F. P. Mennell with the Waterberg system of the Transvaal. For the benefit of readers unacquainted with South African geology, we may add that the Karroo beds correspond to the Permian and Trias systems of Europe, while the Waterberg system belongs to the pre-Cambrian. The various coalfields in Rhodesia do not belong to the same geological horizon, but they all undoubtedly occur in the basal beds of the Karroo. The coal basins are partly produced by folding and partly by a series of step faults. The coal has invariably a high percentage of ash, a characteristic of South African coal generally. The best quality is found at Wankie and Tuli, where the ash is only 8 to 13%, as compared with 15 to 20% usual in South Africa. The Wankie coal is semi-bituminous. Petrological studies show that the coal was not formed in place, but that the vegetable matter of which it is composed was deposited in shallow water in which there were pronounced currents. The Wankie coalfield was discovered in 1894 by A. Giese, who handed the concession to the Mashonaland Agency. The first shaft was sunk in 1901, and production started in 1903. The seam worked is 8 ft. 6 in. thick.



Horwood Flotation Process.—The Proceedings of the Australasian Institute of Mining Engineers, 1913, No. 12, contains a paper by E. J. Horwood describing his preferential flotation process for treating Broken Hill slime. As our readers are aware, the slime is given a roast sufficient to produce a film of lead sulphate on the galena, leaving the blende unaffected, the consequence being that the blende can be floated leaving the deadened galena behind. The process has been definitely adopted by the Zinc Corporation It has a distinct advantage over the processes that seek to raise the lead first, when dump material is to be treated. Such material is always more or less oxidized, and it is difficult to brighten the galena surfaces; on the other hand the blende surfaces are less oxidized, and in any case they brighten immediately on exposure to the acid of the flotation process. Moreover a higher grade zinc concentrate is obtained than with processes where lead is first floated; in the latter processes much of the tarnished galena is left behind with the blende, and tends to rise when the residue is treated for the subsequent flotation of the blende. A recent discovery of note has made it possible to divert more of the silver content to the lead concentrate than hitherto; it was found that if the material was given a preliminary wash in clean water for the removal of the soluble salts before roasting, an effective separation of the lead and zinc constituents could be obtained with a lower degree of sulphatization; this had the effect of making a much higher percentage of the silver content unfloatable and remain behind with the lead material. Before washing was adopted, the lead and zinc products averaged approximately the same in silver, about 30 oz. per ton; with the preliminary washing, the zinc concentrate averages 10 to 12 oz. silver and the lead concentrate 60 to 70 oz. silver.

The plant employed by the Zinc Corporation has a capacity of about 500 tons per week. The slime is washed in a stirring-tank and pumped as thickened pulp to a 50-frame Dehne filter-press. The cakes are washed with fresh water, and compressed air is used for expelling as much moisture as possible. The cakes as discharged contain 10 to 12% moisture. They are delivered through grizzly bars and passed on a conveyor under lightly-running rolls to an Edwards duplex roasting-furnace. This furnace has 12 panels and 48 rabbles, and measures 102 by 14 ft. The fuel is burned in 6 fire-boxes situated on both sides of the furnace in panels numbered 5, 7, 9, and starting from the discharge end. The draught is produced by an induced-draught fan, absorbing less than 3 h.p. The furnace gases first enter a settling-chamber consisting of a circular tank 22 ft. diam. and 8 ft. deep, suitably baffled. The fuel consumption is only 4·8% of the material charged. It is found that the degree of sulphatization sufficient for the process is about 30% of the lead content of the material. The furnace serves the double purpose of dryer and roaster, and excepting that its capacity is slightly reduced thereby, the arrangement is convenient, and it obviates any dusting that a separate dryer might entail. The roasted material is withdrawn by a conveyor enclosed in a dust-proof casing and delivered into a circular tank built of concrete, set at a sufficiently low level to receive all drainage from the flotation plant, and fitted with slowly revolving paddles. The plant liquor circulates through this tank, where most of the acid required for the flotation is also added, it being found advantageous to allow the material the time thus obtained for digestion prior to flotation. A centrifugal pump takes the pulp from the digestion tank, and delivers to a set of 10 alternating agitation and separation flotation boxes of the staggered type used with the Minerals Separation process. The froth made in the first five, and sometimes six, boxes is collected as a final zinc product by revolving paddles, which ensure a minimum quantity of liquor and solids in suspension other than zinc accompanying the zinc concentrate, while the meagre float from the remaining boxes is returned to the first box for re-treatment owing to the presence of lead and gangue with the zinc floated; the reason for this being that, in the final boxes, the percentage of zinc in the pulp is small compared to that of the lead, and it is naturally more difficult to obtain a clean zinc concentrate than is the case in the first lot of boxes, where zinc predominates. The two products (zinc and lead concentrates) resulting from the process gravitate to circular tanks, from which pumps take the respective products and deliver them to filter-presses. The sulphuric acid consumed amounts to from 20 to 27 lb. per ton, while a total of about ¾ lb. of eucalyptus oil per ton is used, some being added to each of the 10 boxes.

At present the zinc concentrate is floated only once, and, as the grade frequently reaches over 50% zinc, it is not yet certain that a re-flotation would be warranted to increase the grade, as is the case in most of the Minerals Separation flotation plants.

The following typical results illustrate recent work done by the process:

	Zinc. %	Lead. %	Silver. Oz. per ton.
Feed to roaster	39	16	18
Zinc concentrate	49·5	6	11
Lead residue	9	47	45

The cost of the treatment is estimated at 20s. per ton.

Weidlein's Leaching Process.—The *Mining and Scientific Press* for April 4 describes the process invented by E. R. Weidlein for recovering copper from ores by leaching with sulphuric acid. Mr. Weidlein has been investigating this class of process at the University of Pittsburgh, and is now erecting an experimental plant at Wabuska, Nevada. The United States patent is No. 1,089,096, and was issued on March 3. The process is based on the reversible reaction:

$$CuSO_4 + SO_2 + 2\,H_2O = Cu + 2\,H_2SO_4$$

The ore is leached with a 3·6% solution of sulphuric acid. After the amount of sulphuric acid has been reduced by the leaching operation to 1%, the remainder of the free acid is neutralized by the addition of the necessary amount of limestone. The solution of copper sulphate containing 1½% copper is sent to an absorption tower, where sulphur dioxide is pumped into it. Subsequently the solution is pumped to precipitation vats, which are made of iron and lined with lead and made strong enough to withstand a high internal pressure. Here heat is applied until a temperature of 150° C is attained, giving a pressure of 100 lb. per square inch. Under these conditions the copper is precipitated in metallic form. The pressure is then released, and the solution emptied on a filter which retains the copper. The solution is sent back to the leaching vats.

Stope-Filling on the Rand.—The February *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa contains a description by E. E. Hardach of the method of sand-filling in use at the Witwatersrand Deep mine during the last two years. The object was to render safe various workings already partly exhausted, and also to support the roof in the upper parts of the mine so as to make it possible to reclaim the pillars and other ore left standing. The system is now being extended to the current stope-faces. Belt-conveyors carry the sand from the treatment-vats into a sluice-box having an incline of 20%, from which it is delivered to two 6-in. Robeson sand-pumps. One of the pumps delivers the sand to a steeply-inclined winze, whence it goes to the south section of the mine; while the other sends it to a 6-in. bore-hole 780 ft. deep for filling the north section. See Fig. 1. The delivery pipes are 8 in. diam. and are made of screwed piping; the pipes for the return water are 9 in. diam. and of a cheaper quality. The pipes are laid 1 ft. below surface and at a slope of 1½% toward the pumps. The delivery pipes are 1200 ft. and 1400 ft. long respectively, and they show no sign of wear. The sand is pumped with 2 to 3 times its weight of water. There are six dewatering cones at the winze and a similar number at the bore-hole. The underflow from the cones contains about 30% moisture. Each cone will handle about 10 tons of dry sand per hour. The sand from the winze is conveyed underground in launders with a minimum grade of 15° wherever it is necessary to deflect it a considerable distance laterally; if not, it is allowed to run on the foot-wall. Deflecting stulls made of 4-in. uprights, wedged in place, and lagged and covered with a strip of jute matting, have been found cheap and serviceable for deflecting the sand for 2 or 3 weeks. In the steep portions of the mine, where the dip is 55°, and also wherever it is desired to keep the level open permanently, the pillars above the level are thinned to 5 or 6 ft. and the box-holes closed with stulls, lagging, and cocoa-nut matting, and the sand filled in above. Where a level is not to be kept open more than 2 years, or where the dip is less than 40°, the pillars are taken out and a line of stulls run 15 or 20 ft. above the level, these being lagged and covered with matting and filled with sand. Cocoa matting is better than jute, as it allows the water to filter through. No difficulty is experienced in retaining the sand in the steep portions of the mine, as it always sets firmly. Precaution is taken, however, by putting in substantial stulls in the steep wide stopes where it is desired to work below the sand-filling. Fig. 2 shows a difficult case. Here a wide 'reef' was stripped down from the hanging wall of a steep stope, the pillars in the old stope being all badly crushed. In some places it had been necessary to put in sand-packs, and then reclaim the reef above them, but generally it was found more economical to take out the reef down the old stopes and follow up with the sand-packs from the sides. In a few cases, as in Fig. 2, the sand-packs had to be put in above. The cost of the sand-filling plant, including the bore-hole, was £7620. Up to January 31 last, 328,645 tons of sand had been put in place underground at a total cost of 7·56 pence per ton.

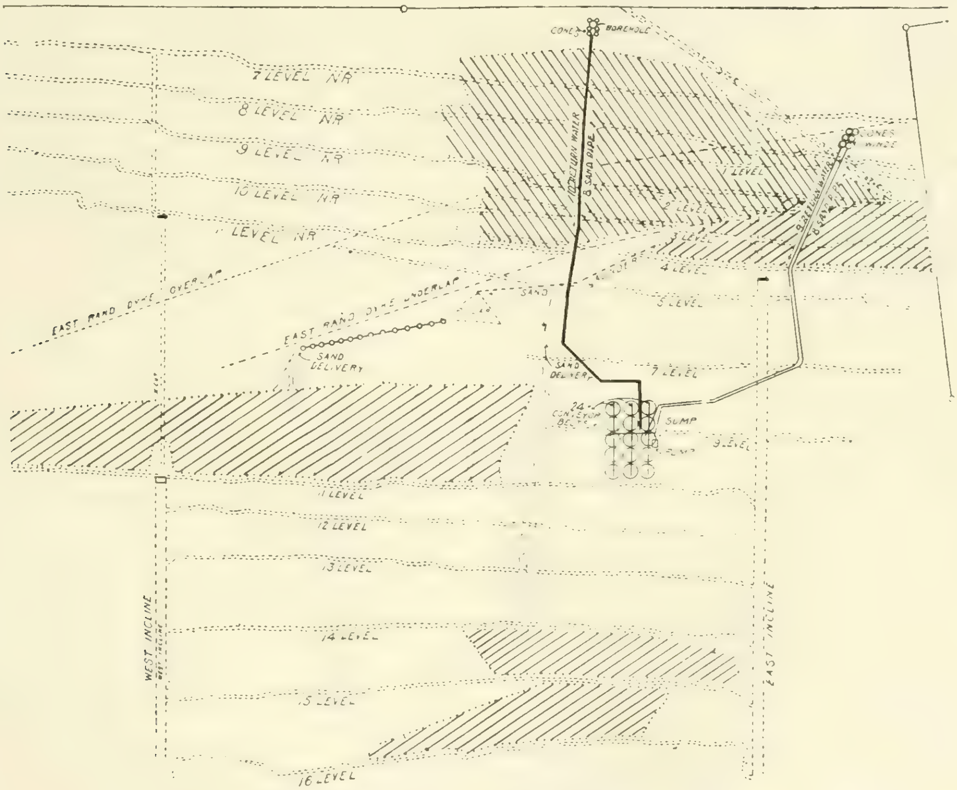


FIG. 1. STOPE-FILLING AT WITWATERSRAND DEEP.

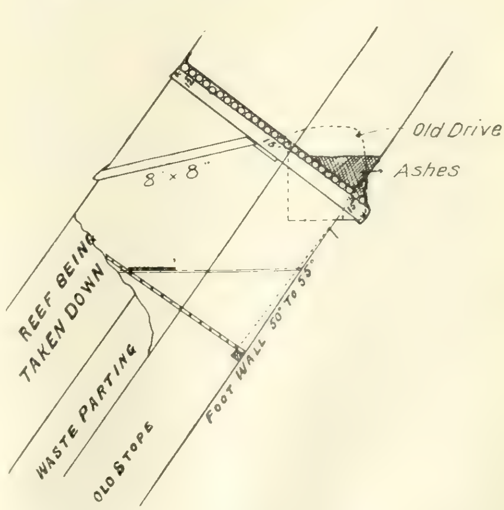


FIG. 2.

Estimation of Zinc.—A paper on the 'Estimation of Zinc in Coinage Bronze by Volatilization' was read before the London section of the Society of Chemical Industry on February 2 by T. Kirke Rose, chemist and assayer of the Mint. The method described was formerly in use at the Mint, and is described by Makins in his 'Manual of Metallurgy,' which was published in 1862. It probably originated in France and was introduced into England at the same time as coinage bronze. This alloy consists of copper 95%, tin 4%, and zinc 1%, and was in use in France for some years before it was adopted in this country. The method was abandoned in 1870, but has recently been revised and re-introduced with modifications.

It consists in heating weighed portions of the bronze in small covered crucibles of gas carbon until the zinc is driven off, and weighing the residue. Air is excluded by packing the crucibles in a larger salamander crucible and covering with powdered charcoal. After heating for two hours at 1375° C. in a gas injector furnace, the bronze retains 0·03% of zinc, and has lost 0·2% of copper and tin. Check-assays of similar composition to the bronze enable a correction to be made for the retention of zinc and loss of other metals. The figures of results quoted by Dr. Rose show that the method is subject to errors of about 0·03% when a correction is made based on the results of check-assays. Estimations made in this way occupy very little of the assayer's time compared with determinations by the usual gravimetric or volumetric processes; if the furnace work can be delegated to an assistant, a duplicate assay involves only about five minutes work.

Brass or other alloys containing a large amount of zinc can be assayed by this method if care is taken not to heat too strongly at first. The zinc is soon reduced to about 5% at 1000° C., and with subsequent heating, as in the case of coinage bronze, results are obtained in which the loss is 0·1 or 0·2% too high. This error could be allowed for by making check-assays on metal of known composition similar to the alloys tested.

If oxygen is present in the alloy, as oxide of zinc, it is almost entirely removed and would be reckoned as zinc. When zinc is to be determined in bronze as a check on the results for copper and tin, this would be rather an advantage than otherwise. In the case of coinage bronze and similar alloys the amount of this error is very small.

Ore Deposits at Kyshtim.—The March *Bulletin* of the Mining and Metallurgical Society of America contains a paper by A. W. Stickney describing the pyritic ore deposits at Kyshtim in the Ural mountains. In our issue of June 1912 H. W. Turner described these deposits. Mr. Stickney's paper gives a useful summary up to date and we quote it at length.

The deposit is a compact, dense, massive aggregate of granular pyrite, barite, and quartz, carrying irregular blotches, streaks, and minute grains of chalcopyrite, sphalerite, and tennantite. The evidence indicates that the ore is the result of the metasomatic replacement of alternating bands of a sheared and broken schist by a rather fine-grained, cracked, and broken pyrite, anhedral barite, and quartz. This granular aggregate contained considerable open interstitial space, which was later filled by contemporaneous chalcopyrite, sphalerite, and tennantite. Tennantite probably also marks a slightly later stage in the primary mineralization, and with it are contemporaneously associated chalcopyrite and quartz of a second generation. The paragenesis of the sulphide minerals is one of decreasing iron, and increasing copper contents.

The orebodies, as viewed in a vertical section, normally show four distinct roughly horizontal and parallel zones. From the outcrop downward they may be designated as: (1) the gossan zone, which extends from the surface to a maximum depth of 60 ft.; (2) the zone of loose baritic sand, extending from the bottom of the gossan to a maximum depth of 150 ft., the greater portion of which lies beneath the level of the ground water; (3) the loose, leached sulphides, which reach from the bottom of the baritic sand to a maximum depth of 180 ft., where they gradually pass into (4) the underlying, firm, massive, mainly unaltered sulphide ore.

The evidence indicates that the gossan is the result of normal processes of oxidation acting upon the massive sulphide ore, since the gossan (*a*) displays the honeycomb skeleton form of the primary ore with the metallic sulphides removed; (*b*) overlies a much narrower zone of loose baritic sand, which carries only about one-fourth as much iron as the gossan, and is strikingly distinguished from the gossan zone by a broken and caved hanging wall; and (*c*) this broken hanging wall reaches the surface in the case of the one lode of which the outcrop is predominantly baritic sand. It is believed that during a period in the remote past the rate of denudation has been much faster, as the result of a steeper gradient or of glaciation, whence the massive pyritic ore was kept so near to the surface that an excess of oxygen was always immediately available to convert into limonite the iron of any ferrous sulphate formed. Since that time these conditions have ceased to exist, owing to long continued erosion or to climatic changes. The baritic sand is regarded as the result of leaching by surface waters, which probably contained sulphuric acid, but were deficient in oxygen; the iron sulphate and much of the copper sulphate thereby generated were lost by diffusion into the relatively more permeable wall-rock.

As this leaching has occurred to as great a depth as 110 ft. below the ground-water level, which apparently has been stationary for a long period, it is inferred that the upper portion, at least, of the ground water is not so stagnant as some have supposed. A distinct circulation of this water, both vertically and horizontally is suggested. There is no evidence to support the hypothesis that the gossan was formed by iron sulphate solutions, ascending through the underlying extensive zone of baritic sand, the iron being fixed as limonite in the gossan by descending surface waters heavily charged with oxygen. There is nothing to suggest that gossan is being formed at the present time; on the contrary, it is inferred that all the present gossan is a remnant of that formed in a previous period, which has not as yet been removed by erosion except in the case of one lode, where topographic conditions appear to have been and are still favourable to rapid denudation. Here the underlying zone of baritic sand outcrops.

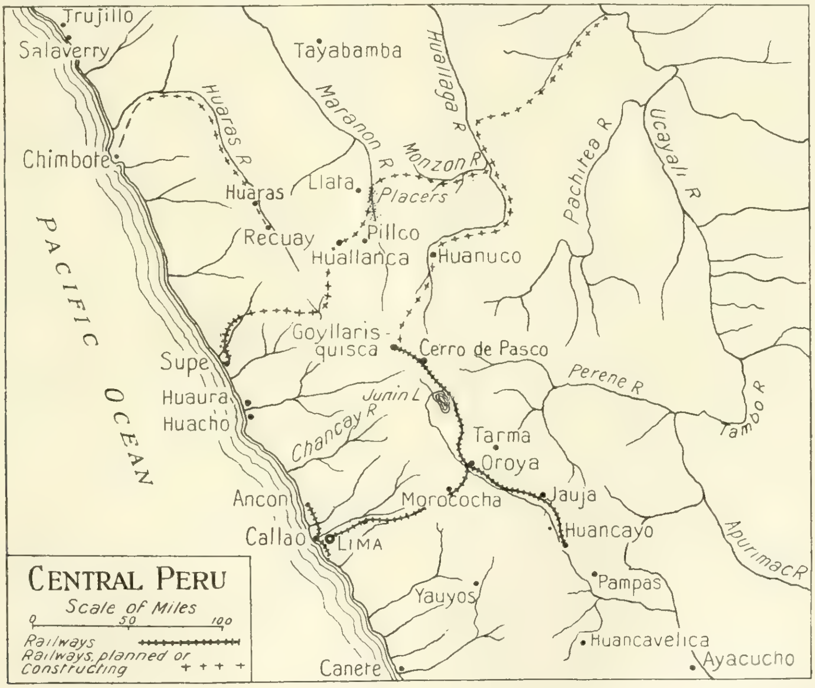
Downward enrichment of secondary sulphide does not occur in the form of a shallow, well developed, commercially important, horizontal zone, typical of many other localities, but has taken place to a relatively slight degree along the immediate walls, especially the hanging wall, to the greatest depth yet attained in exploration, which is 600 ft. below the ground-water level.

The massive pyritic ore of a given lode shows a progressive longitudinal variation in relative mineralogical character, from a condition of maximum intensity of mineralization near the longitudinal centre of lode, which continues downwards to the greatest depth yet reached.

The character and composition of the ore, and the nature of the hydrothermal alteration of the wall-rock, indicate that the deposits have been formed through metasomatic replacement, along a sheared zone of the schist, by pyrite and barite, molecule by molecule, band by band, thus preserving the original banding of the schist; also, that the deposition took place during a distinct mineralizing epoch, marked by solutions progressively changing in composition and depositing a series of sulphide minerals in transitional order. From the absence of characteristic ore minerals in the adjacent altered country rock, and the present of sericite, barite, and quartz, it is concluded that the mineralization was effected by hot alkaline solutions at a temperature and pressure corresponding to what Lindgren in his 'Mineral Deposits' calls the zone of intermediate depth.

Marañon Placers, Peru.—Our Lima correspondent has referred to the venture of the Peruvian Exploration Co., a New York company organized to exploit gold placers on the Marañon river, Peru. The unusual extent and richness of these placers mark them as important future producers of gold, that is, if the estimates of the engineers are verified by results. The American press has considerable doubt as to the reliability of the estimates of the engineers, and we would draw attention to the opinions expressed by the *Mining and Scientific Press* for February 7 and April 11. The placers were discovered by Raymond McCune, an engineer on the survey of the Amazon-Pacific or Ucayali railway, of which Mr. McCune's father was one of the organizers. A descriptive article, with photographs and maps, appears in the November issue of *Peru Today*, a monthly magazine published at Lima, and from this we cull the information following.

The head-waters of the Marañon or Amazon river are within 40 miles in a northwesterly direction from Cerro de Pasco. The rivers Huallaga and Ucayali also rise in the Andes and join the Amazon farther north. The accompanying map shows the region. The placers are in the districts of Huallanca and Llata, department of Huanuco, and are from 80 to 100 miles north of Cerro de Pasco. They can be reached by way of Callao and the Cerro de Pasco railway, and thence by trail. An alternative route is by the port of Supe and thence by trail. The Ucayali railway when built will afford communication by way of Huanuco and also through the Monzon river valley. A scheme is also under consideration for the construction of a railway from the port of Supe that will pass through the property. It is believed that the stretch of river 20 miles long was the scene of mining activity in the early days of the Incas. The ancient Inca town Pillco, now called Old Huanuco, was second in importance to Cuzco, and the ruins still extant testify to the existence of a large and prosperous community. This town undoubtedly had close connection with the mineral riches, and it in fact guarded the approach to them. In other places fortifications are still to be seen protecting the entrance to the valley. There is evidence that the sides of the river and the higher benches were worked by the Incas; and very thoroughly too, for little gold remains in them. An investigation of the river bed, however, tends to prove that little or no work was done below the surface of the water. The exploratory tests made by Mr. McCune are reported to have disclosed the presence of over a hundred million dollars worth of gold, distributed throughout the gravel at an average content of 81 cents per cubic yard. He talks also of unexplored bottom gravel expected to be full of nuggets, and mentions $500,000,000 as the possible total content. Owing to the difficulties of transport, it would be well-nigh hopeless to attempt to build a dredge. The plan is therefore to divert the river and expose the bed. Five 9-in. giants are to be installed, and the gravel sluiced at a rate of 25,000 cu. yd. per 24 hours. The river gravel consists of the detritus of rocks consisting of schist and slate, through which gold-bearing quartz veins penetrate. In size it varies from fine sand to stones up to 10 in. in diameter. There are no awkward boulders. The gold is coarse, and much of it is angular, so that it has apparently not been carried far. Except in the rainy season, the river averages 100 ft. wide and 3½ ft. deep, and the flow is about 4 miles per hour. The river on being diverted will be enclosed within a channel 20 ft. wide and 15 ft. deep. The placers are at an altitude of 10,000 ft., and the mountains rise 6000 to 10,000 ft. higher on each side. Water-supply is abundant and the climate is pleasant.



Shaft-Construction by Rising.—In our issue of March 1913 we gave an account of the construction of a shaft by enlarging a bore-hole from below upward. A similar procedure has been recorded in a paper read by H. B. Pilkington before the Manchester Geological and Mining Society on April 7. At the No. 2 pit of the Newtown colliery near Manchester it was desired to sink the shaft 195 ft. to tap another coal seam without interfering with the current hoisting of coal through the shaft from two upper seams. A 10 in. bore-hole was sunk from the bottom of the existing shaft to the road driven in the seam to be developed. Through this bore-hole was suspended a capstan rope which held a working scaffold of special design.

The scaffold was double-decked, the upper deck being the working floor for drilling the roof and trimming the sides, and the lower deck being used as a banking level and bricking scaffold. The top deck was 16 ft. 9 in. in diameter, the finished diameter of the shaft being 16 ft., and it always rested on the brickwork during drilling and blasting operations. It was constructed with a 5 ft. square opening on one side of the centre line. The framework consisted of three parallel baulks of 12 by 9 in. pitch pine, planked over with 3-in. planks covered with old boiler plates. The lower deck was 6 ft. 3 in. below the top deck, and was secured by four main posts at the corners of the opening previously referred to, and also by eight 2-in. iron bolts round the edge of the framing. This deck was built 15 ft. 8 in. in diameter, being 4 in. less than the inside diameter of the finished shaft. Two 5 ft. square openings were provided, one being directly below the opening in the top deck and the other symmetrically opposed to it on the other side of the centre line, and through this the hoppet was raised and the men and materials landed on to the lower deck by means of two small pulleys fixed above it to take the winding rope used for the hoppet. This opening was protected by three movable bars. The other opening, which had the four posts at its corners, was planked in from the lower to the upper deck, thus forming a box. Two small rectangular man-holes were cut in two sides of this box, and these formed the means of reaching the top scaffold. The floor of this box was formed by two doors, which opened downwards, and as the safety of the workers both on the scaffold and at the bottom of the shaft depended on these doors, special precautions were taken to keep them shut. In the first place they were heavily counter-weighted until they could support more than the weight of a man, even if not secured in any other way; secondly, they were fitted with a powerful screw brake, which was always kept screwed hard on; and thirdly, there were two trigger catches, operated by a hand lever, which advanced under the doors when they were shut. The doors themselves were of solid construction and armoured with iron plates. These precautions were necessary to prevent any débris falling on the men when ascending after blasting, or when working below the scaffold filling out the débris. There were also two small emergency doors to get from the bottom deck to the top, in case the main way was impeded by any large stones. The lower deck was also fitted with six ordinary prids of substantial design, which were used in the usual way. Four diagonal stays were fitted from the framing of the lower deck to take the weight of the scaffold when attached to the bridle chains, which were attached to the capstan each time the scaffold had to be raised for putting in a new length of brickwork. After this was finished the scaffold was packed up and the main baulks allowed to rest on top of the brickwork, the prids on the lower deck being knocked into holes left for them. When the scaffold was thus doubly secured in this position, the capstan rope was detached and the chains let slack on the top deck so as to leave a free and open space for work, and to remove the capstan rope away from any danger from blasting.

Electric Traction in Mines.—The February *Bulletin* of the American Institute of Mining Engineers contains a paper by Charles Legrand, of the Copper Queen mine, Arizona, on electric traction in mines. This paper contains many useful hints.

With the gauge of track usually 18 or 20 in., the weight limit of locomotives obtainable from manufacturers in America varies from 3 to 6 tons. The full-load speed varies from 4½ to 6 miles per hour. These locomotives, being made to run on curves of very small radius, have a short wheel-base and a long overhang from axle to coupling; this necessitates a coupling with a good deal of lateral motion to avoid derailing the cars on sharp curves, especially if couplings are of the standard automatic type. Although 3-ton locomotives will run on 12 or 16 lb. rails, it has been found more satisfactory to use 25 lb. rails, as the track keeps in much better shape; it is easier to maintain the bonding in good order, and fewer derailments from dirt on the track occur with the larger rails. Where 6-ton locomotives are used the 25 lb. rails are satisfactory, but 40 lb. rails have proved cheaper where the traffic is heavy and the ground is soft, as the track maintenance is considerably lower with the heavy rails. The locomotives will run on 15 ft. radius curves, but on through runs it is advisable not to go below 40 ft. radius.

The voltage used should not exceed 250 to 275 volts, and the trolley wire should be protected, to prevent accidental contacts, in front of chutes and at all points where the wire is low. With the air somewhat deficient in oxygen and with the heat and high humidity prevalent in many mines, this voltage, which was considered perfectly safe, has proved fatal in several instances, and in such mines it is advisable to have a pulmotor available and men trained to use it in case of accident. The trolley wire should be protected from dripping water, particularly if the water is acid. The track-bonding should be kept in good order. This is one of the most difficult things to do, as most of the trackmen in the mines do not realize the importance of it. A badly bonded track will increase the repairs of motors considerably, as in passing from a dead rail to a live one the sudden rush of current is liable to form an arc across the motor commutator or from the commutator to the ground. If the locomotive is not mounted on springs it has been found advisable to put the resistance grids on springs, with flexible leads to the controller, as on small locomotives the cast metal grids are light and easily broken.

In a mine laid out for hand tramming the slope is generally made in favour of the loaded cars, so that the load is fairly uniform going down with the loaded cars and coming up with the empty cars. This gives ideal conditions for a full load on locomotives at all times; but the motors on electric locomotives are seldom made so that the locomotive can deliver its full tractive effort continuously, and this ideal operating condition leads to overheating of the motors and heavy repairs, unless the number of cars attached to the locomotive is kept down to the maximum that the motors can pull without overheating. This is difficult in practice, as it seems against human nature to run a locomotive of any kind with a load that does not slip the driving wheels when starting or at every point in the track where conditions are unfavourable. The difficulty of getting motors of sufficient size in the small space available with 20-in. gauge has made it necessary for the author, in one or two instances where traffic is heavy and continuous, to build his own locomotives, putting the motors above the wheels and gearing to the axles outside of the wheels. This makes a cumbersome design, but allows the use of larger motors and has proved satisfactory in service. Even with this design the necessary clearance in the drifts limits the weight of locomotives to about 7 tons.

Where the tonnage to be handled is not great and yet mechanical traction is advisable a storage-battery locomotive is convenient. The running expenses are not much greater than with a trolley system. The Copper Queen Mining Co. operated a 3-ton storage-battery locomotive at Bisbee for over two years, under the worst conditions of any locomotive in their mines as regards track and curvature, and the results were better than the writer anticipated. To make use of one of the regular locomotives, the battery, consisting of 150 Edison cells, was mounted on a separate trailer. This battery had a total output capacity of 40 kw-hr., the average voltage on discharge being 180 volts. The first trays furnished to hold the cells were of the regular type for automobiles and proved to have too small a clearance between cells. The hard bumping in switching combined with heavy sweating (due to the locomotive going from hot portions of the mine with moisture-saturated atmosphere to colder portions near the shaft) short-circuited the cells externally. After the trays were altered to provide larger clearances and the cells were painted with insulating paint, there was no trouble from this source. The power required at the power station per useful ton-mile was approximately double that required with trolley locomotives, or 1·6 kw-hr., due to the extra dead weight of the battery car and the lower efficiency of the battery compared to the trolley wire and track circuit, also to the losses in the motor generator used in charging the battery. With a locomotive designed to carry batteries, the difference in power would be less. The power would also have been reduced if a motor controller had been used, grouping the cells in various combinations for starting, instead of a regular controller with starting resistances. The traffic became too heavy to be handled with this locomotive and it did not run long enough to provide figures on depreciation of the storage-battery. The maintenance of the battery-locomotive motor was less than on the trolley locomotive, but no exact figures are available. The capacity of the battery was approximately 50 useful ton-miles on one charge.

At the mines of the Copper Queen Mining Co., in Bisbee, the power used on trolley locomotives, measured at the direct-current switchboard in the power station, for the year 1912, amounted to 875 watt-hours per useful ton-mile. This amount, however, includes a few lights which are connected to the trolley circuit, and gives too high a figure for the locomotives alone. It applies to cars with roller bearings, about one half of the tonnage being carried in cars of 2 tons capacity and the other half in cars of 1 ton capacity. The conditions of the cars and track have an important bearing on the power required per ton-mile, although the writer has no accurate figures. A rough idea can be formed from the fact that on a certain track in the mine of the Moctezuma Copper Co. one 3-ton locomotive cannot pull more than five cars of 20 cu. ft. capacity, equipped with regular Anaconda axles, without slipping the wheels, while the same locomotive pulls six cars of 22 cu. ft. capacity equipped with roller bearing axles.

For the year 1912 the cost of various items in cents per useful ton-mile at Bisbee for a total of 408,000 ton-miles was as follows: Locomotive maintenance, 2·95; Car maintenance, 1·64; Track maintenance 5·24; Trolley maintenance, 3·60; Power, 1·64.

CURRENT LITERATURE.

Efficiency in Crushing.—In the *Engineering and Mining Journal* for April 18, Arthur O. Gates presents an article expanding one published in the issue of May 24 of last year, further explaining his system of graphic calculation of the energy absorbed in comminution, based on Rittinger's law.

Mining in Peru.—In the *Mining and Scientific Press* for March 21, Lester W. Strauss reviews the progress of mining in Peru during 1913.

Globe, Arizona.—In the *Mining and Scientific Press* for March 14 and 21, W. L Tovote describes the geology of the Globe mining district, Arizona.

Harney Peak Minerals.—In the *Mining and Scientific Press* for April 11 and 18, Victor Ziegler writes of the mineral resources of the Harney Peak pegmatites. This district in Black Hills, Dakota, was twenty or more years ago of interest to English investors who placed much money in an abortive tin-mining venture.

Yuba All-Steel Dredge.—In the *Engineering and Mining Journal* for March 28, April 4 and 11, L. H. Eddy describes the all-steel dredge of the Yuba company, California.

Flow of Sand.—The *Journal of the Franklin Institute* for April contains a paper by E. A. Hersam on the flow of dry sand through orifices.

Efficiency of Cyanide.—In the *Mining and Scientific Press* for March 28, Charles Butters, E. M. Hamilton, and J. E. Clennell record the results of experiments at the Salvador mine as to the relative efficiency of sodium and potassium cyanide.

Brown Cyanide Patents.—The *Mining and Scientific Press* for March 28 and April 4 gives an account of the litigation with regard to the Alden H. Brown patent, which claimed the use of cyanide in the stamp-mill with subsequent concentration of the sulphides. The Appeal Court held this patent to be invalid, thus reversing the decision of the court of first instance.

Leaching at Butte-Duluth.—In the *Mining and Engineering World* for April 4, Peter E. Peterson describes modifications recently introduced at the leaching plant for treating oxidized copper ores at the Butte-Duluth mine. The process was described in our issue of December last.

Precipitation of Copper from Solution.—In the *Engineering and Mining Journal* for April 11, Stuart Croasdale discusses the precipitation of copper from sulphate solutions obtained by leaching oxidized ores. His experiments showed that if ferrous sulphide was added to a 2% solution of copper sulphate metallic copper was precipitated. Under certain circumstances, the writer considers that this reaction will be useful in hydrometallurgical processes.

Short Tube-Mills.—The *Engineering and Mining Journal* for April 18 describes the Traylor short tube-mill, measuring 7 ft. diameter and 6 ft. long. This type is not intended for sliming, but for producing material suitable for concentrating operations.

Platinum Assay.—In the *Mining and Scientific Press* for April 11, G. H. Clevenger and H. W. Young present a chart of operations for the fire assay of ores for gold, silver, and platinum, the determination of the presence of the last-named metal being of value nowadays, when the metal is sought keenly.

NEW BOOKS

The Romance of a Malayan Tin Field. By E. J. Vallentine. Cloth, octavo, 40 pages, with illustrations and maps. Printed privately for the author by *The Mining Journal*, London.

In these days, when the Malay Peninsula is attracting so much attention, it is well to have some literature bearing on the historical aspect of the tin-mining industry of the region. Four hundred years ago the Dutch and English traders taught the aborigines the value of the tin deposits. Subsequently the Chinese came southward and conducted operations on a larger scale. Until a few years ago Malayan mining was entirely in the hands of the Chinese. Mr. Vallentine has for some years been manager of the Rahman mine at Intan, in the northern part of Perak, a district isolated from the better known centres in the Kinta valley and Taiping. Intan has had a chequered history. Being on the border of Siam and Perak it has been the theatre of many bloody strifes. It is only five years ago since the district was handed over to Perak on the conclusion of a treaty between Siam and Great Britain. Mr. Vallentine has pieced together the tragic history of this remote region, and presents it in a readable and attractive manner.

Alloys and their Industrial Applications. By Edward F. Law. Cloth, octavo, 332 pages, with many illustrations. London: Charles Griffin & Co. Price 12s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This is the second edition of a book that has won considerable success among practical metallurgists. It is not too deeply scientific and theoretical, but is intended rather to give commercial information relating to the nature, composition, and applications of alloys. For instance it gives details of the effect of various metals added to steel.

Practical Coal-Mining. By George L. Kerr. Cloth, octavo, 780 pages, illustrated. London: Charles Griffin & Co. Price 12s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This is the fifth edition of a book that has enjoyed a much deserved vogue among colliery managers and engineers. Recent legislation has made it necessary to revise and expand in many chapters, especially in connection with timbering, mine gases. safety lamps, and rescue apparatus.

Details of Cyanide Practice. By Herbert A. Megraw. Cloth, octavo, 220 pages, illustrated. New York: McGraw-Hill Book Co. Price 8s. 4d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

A feature of unusual interest in the pages of the *Engineering and Mining Journal* during the last two years has been the series of articles by Herbert A. Megraw, describing present practice at a great number of cyanide plants throughout the United States and Canada. Mr. Megraw is a competent cyanider, and he has been able to present his material with a due regard to the correlation of practice at the various centres, and to give his own opinions in such a way as to elicit useful discussion. The book contains many records that will be valuable over here as well as in America; for instance the descriptions of practice at Dome, Hollinger, and Nipissing. Modern practice in California and Nevada is exemplified by the plants at Tonopah, Grass Valley, and elsewhere, and details are given of methods at the Liberty Bell, Telluride, and in the Black Hills, South Dakota. The book is rendered additionally interesting by the inclusion of reprints of much intelligent criticism and discussion.

The Co-operation of Science and Industry. By S. Roy Illingworth. Leather, pocket size, 96 pages. London: Charles Griffin & Co. Price 1s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Mr. Illingworth makes an eloquent "plea for the closer union of industry and applied science." Though science has made much headway in England, its progress has too often been in the face of opposition on the part of the employer and manufacturer. To be effective in the improvement of commerce, science should be sought eagerly, and not allowed to be the patient suppliant at the door of the factory. The author's object is to place before commercial men the ability of science to help industry on genuine business lines.

Laboratory Manual for Glass-blowing. By Francis C. Frary. Cloth, octavo, 60 pages, illustrated. New York: McGraw-Hill Book Co. Price 3s. 2d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This is an extremely useful manual for glass work required in the laboratory, and is intended particularly for use at works, mines, etc., far away from centres of civilization.

Compressed Air Practice.—By Frank Richards. Cloth, octavo, 330 pages, illustrated. New York: McGraw-Hill Book Co. Price 12s 6d. net, For sale at the Technical Bookshop of *The Mining Magazine*.

Twenty years ago, Mr. Richards wrote a useful hand-book, 'Compressed Air.' Since then mechanical improvements have reduced the cost of compressing air by two-thirds. The new edition of the book describes the principles of air-compression, the turbo-compressor, the hydraulic air-compressor, the internal-combustion pump, the air-lift, and many other applications.

Oil and Petroleum Manual 1914. By Walter R. Skinner. Cloth, octavo, 250 pages, illustrated with maps. Price 4s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This is the fifth yearly issue of an acceptable year-book, which gives particulars of the companies registered in London devoted to the oil industry. In a succeeding paragraph we note the publication of the rival handbook. We hope these will be amalgamated, in the same way as the two mining year-books published by the same two firms.

Oil Handbook. Cloth, octavo, 280 pages. London: *The Financial Times*. Price 2s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This is the fifth yearly edition of a useful handbook giving details of all the companies known in London connected with the production of petroleum.

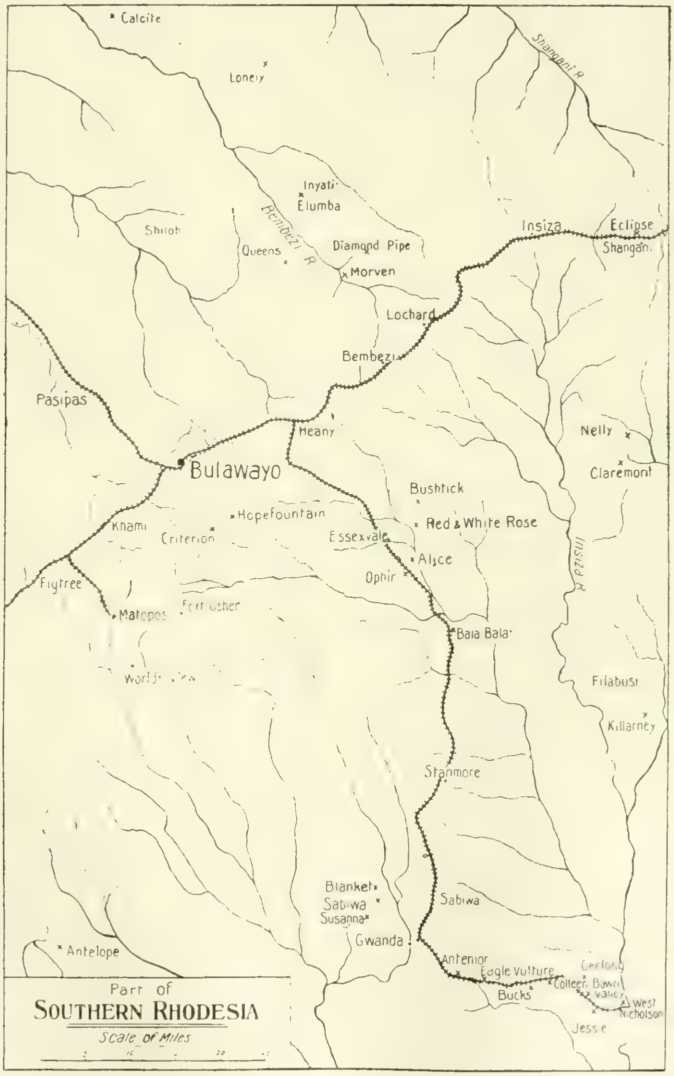
Baumé and Specific Gravity Tables for Liquids Lighter than Water. By Nat H. Freeman. Cloth, pocket size, 28 pages. London: E. & F. N. Spon. Price 2s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Useful Minerals and Rare Ores. By Alexander McLeod. Leather, pocket size, 114 pages. New York: John Wiley & Sons; London: Chapman & Hall. Price 5s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

The full title of this book is: "Practical instructions in the search for and the determination of the useful minerals, including the rare ores, for the prospector, miner, and as a ready reference for everybody interested in the mineral industry."

COMPANY REPORTS

Lonely Reef.—This company was formed in 1910 under Rhodesian laws, by Lewis & Marks, to acquire a group of partly developed gold mines, together with a reduction plant, situated 55 miles north of Bulawayo. Francis Drake is consulting engineer and S. H. Boright is manager. In previous years the directors have made much of the regularity in the length of shoot and the gold content on the various levels. It is a disappointment therefore to find from the yearly report for 1913 now published that the development has recently been in poorer ground. On the 8th, 9th and 10th levels, the main drifts have passed through 1400 ft. of ore disclosing 56,931 tons of unspecified gold content, and during the year 58,903 tons was mined and sent to the mill. The ore reserve at the beginning of the year was 174,529 tons averaging 22·4 dwt. per ton, and at the end of the year 172,557 tons averaging 17·14 dwt. A calculation will show therefore that the average content of the ore disclosed during the year was only 7 dwt. per ton. As recorded a year ago, the orebody pitches in depth away from the main vertical shaft, so an inclined shaft is now being sunk from the 9th level. The ore milled during the year yielded 52,011 oz. gold worth £220,510 by the all-sliming and cyaniding method. The recovery was 17⅜ dwt. or 74s. 2d. per ton. The profit was £126,392, to which £31,214 was added as balance brought forward from the previous year, making a disposable total of £157,606. Out of this, £53,708 has been appropriated to capital expenditure, £9403 paid as taxes, and £81,302 distributed as dividend, being at the rate of 30% for the year.



Part of
SOUTHERN RHODESIA
Scale of Miles

Globe & Phœnix.—This company was formed in 1895 to acquire gold mines in the Sebakwe district of Rhodesia, 140 miles north of Bulawayo. The Globe mine did not last for long, but the Phœnix has provided rich ore down to a dike between the 15th and 16th levels. H. A. Piper and A. J. Fraser are the consulting engineers, and Theodore Haddon is manager. The report for the year 1913 gives details of development down to the 21st level. The lodes have not been proved continuously profitable at this depth, but here and there, especially at the north end of the 20th level, ore of high grade has been found. In order to maintain the output of gold it has been necessary to draw upon the reserve of extra rich ore. The ore reserve on December 31 was estimated at 180,757 tons averaging 27·2 dwt. per ton, as compared with 170,954 tons averaging 33·8 dwt. the year before. The reserve of very rich ore has been reduced from 23,503 tons averaging 116 dwt. per ton to 14,426 tons averaging 110 dwt. During the year, 76,051 tons of ore was raised, and the yield was 118,446 oz. gold worth £500,971. The net profit was £303,355, out of which £250,000 was distributed as dividend, being at the rate of 125%. The new vertical shaft has been sunk to 1896 feet.

Basset Mines.—This company was formed in 1896 to acquire the Basset and South Frances tin mines, previously worked on the cost-book system, situated 3 miles to the south of Redruth, Cornwall. Francis Oats is chairman of the board, and William James is manager. The capital is £120,000, divided into two sets of cumulative preference shares, preferred ordinary shares, and deferred ordinary shares. The only dividends so far distributed have totalled 22½%, paid on the preferred shares in 1911 and 1912. The report for the year 1913 shows that 51,087 tons of ore, including 2874 tons from the dumps, was milled for a return of 574 tons of tin concentrate, as compared with 46,646 tons, including 4126 tons of dump material, treated during 1912 for a return of 502 tons of concentrate. The yield per ton was 25·2 lb. as compared with 24·1 lb. Owing, however, to the lower prices of the metal, the income was only £67,695, as compared with £66,223, the average price obtained per ton being £117. 16s., as compared with £131. 8s. 6d. With regard to the accounts, the total income was £68,570, and the total expenditure £65,939, leaving a profit of £2631, of which £2253 was written off. Development has been pressed during the year, the amount done being 3804 ft., or 1 ft. for every 12 tons raised. No undue amount of water has entered the mine during the year. The analysis of the accounts shows that the income from the sale of tin was 26s. 6d. per ton of ore, and the cost 25s. 11d. per ton. The cost was 10d. per ton less than in the previous year.

Mason & Barry.—This company was formed in 1878 to acquire the San Domingos sulphur and copper mine at Mertola, Portugal, in the same mineral belt as the Rio Tinto and Tharsis. The mine was worked privately by the vendor company for 20 years previously. In 1892 and subsequently, the nominal capital was reduced by the return of cash out of profits, the denomination of the shares being gradually reduced from £5 to £1. The present capital is £185,172. The report for the year 1913 shows that 378,929 tons of ore was raised, and that the shipments were 363,208 tons. No details are given of the nature of this ore, or of the amount of copper produced or contained in the ore. The net trading profit was £76,211, out of which £64,810 was distributed as dividend, being at the rate of 35%, the same as last year.

Tharsis Sulphur & Copper.—This company, with headquarters in Glasgow, operates the Tharsis and Calanas pyrite mines in the south of Spain. It was formed in 1866 and has paid dividends continuously. The report for the year 1913 shows that 30,248 tons of ore was raised from the Tharsis mine and 300,514 tons from the Calanas mine. The amount of pyrite shipped was 508,287 tons, and the production of copper was 3218 tons. The net profit for the year was £246,726, and the sum of £250,000 was distributed as dividend, being at the rate of 20%. The total distribution to date has been £10,008,432, being 888⅛%. In addition, £2,536,812 has been written off property and plant account out of profits.

Balaghat Gold.—This company belongs to the group operating in the Kolar district of India under the management of John Taylor & Sons. The mine is the most northerly of the five producers, and has been the least successful. Work was started in 1886, but three reconstructions were necessary before any profits were made. Dividends were paid from 1900 to 1907, the total distribution being £227,800. Since the latter date, the amount of ore raised and the gold content have both fallen. For the last five years, the mill has been worked at about two-thirds capacity, and the yield per ton has been about 30s., or only about half of what it was ten years ago. The report for the year 1913 shows that 42,700 tons of ore was milled, yielding gold worth £67,103. The working cost was £62,731, royalty £3318, and allowance for depreciation £3647. There were other items of revenue totalling £2737, and the net result of the year's operations was a loss of £910. H. M. A. Cooke, the superintendent, reports the ore reserve on December 31 at 21,886 tons, as compared with 24,725 tons a year before. Developments on the 3175-ft. level have disclosed an orebody, which though of comparatively low grade contains occasional rich patches. Work is now in hand having for its object the testing of this section of the ground at the 2300-ft. and 2600-ft. levels, and sinking is to be commenced below the 2600-ft. and 3175-ft. levels. The present prospects are considered brighter than for several years past.

Buena Tierra.—This company was formed by the Exploration Company in February 1912 to acquire a silver-lead property in the Santa Eulalia district, Chihuahua, Mexico. R. M. Raymond is consulting engineer, and A. C. Brinker is general manager. The ore is lead carbonate, high in iron, with some silver, and it is shipped to the American Smelting & Refining Co.'s smelter at Chihuahua. The report for the year 1913 shows that the smelter ran intermittently until November 1, when operations were temporarily suspended owing to the political disturbances. Last month the smelter was entirely closed-down. During the year, 25,972 tons of ore was shipped, averaging 14% lead and 8·22 oz. silver per ton. The income was $181,689, an average of $7 per ton. In English money the revenue was £44,290, and the balance of profit £16,533. No dividend was distributed. The development work has been curtailed, but the reserve has been fairly well maintained, at 300,000 tons.

Broken Hill Proprietary.—The report for the half-year ended November 30 last shows that 158,863 tons of ore was raised, of which 148,875 tons of sulphide ore was treated in the concentration plant, for a yield of 29,828 tons of lead concentrate averaging 58·3% lead and 25·88 oz. silver per ton. In the re-grinding plant, 122,915 tons of tailing was treated, yielding 3532 tons of concentrate averaging 51·1% lead and 25·63 oz. silver per ton. The zinc-concentration plant treated 181,463 tons of tailing for a yield of 43,914 tons of zinc concentrate averaging 45·9% zinc, 7·39% lead, and 12·9 oz. silver per ton. These figures of output and yield were all greater than during the previous half-year, an increase due chiefly to the better supply of miners. The lead-concentration plant was extended by the erection of additional jigs and Wilfleys. A fourth lead furnace was blown-in at the Port Pirie smelting works during October. The material smelted during the half-year included 11,921 tons of oxidized ore, 87,797 tons of concentrate and slime, 3702 tons of zinc-retort residue, and 791 tons of flue-dust. A large proportion of the sulphide material was purchased from adjoining mines. The output of the lead smelters was 47,197 tons bullion. The refinery dealt with 48,563 tons of bullion, from which was extracted 44,056 tons of hard lead, 356 tons antimonial lead, 2,246,531 oz. silver, and 1189 oz. gold. At the zinc plant, from 7 to 9 distilling furnaces were under commission according to the labour available, and the production was 2191 tons of spelter and 252 tons of blue powder, from an unspecified amount of zinc concentrate. The net profit for the half-year was £143,773, out of which £90,000 was distributed as dividend. The report describes the progress of the iron and steel works at Newcastle. Practically the whole of the material required in their construction is now on the spot.

Sons of Gwalia.—This company was formed in 1898 to acquire a gold mine at Mount Leonora, in the North Coolgardie district of West Australia. Bewick, Moreing & Co. are the general managers. Dividends have been paid with regularity since 1903. The report for the year 1913 shows that 162,101 tons of ore was raised and sent to the 50-stamp mill. The yield by amalgamation was 21,008 oz., by cyaniding sand 5494 oz., by cyaniding slime 32,692 oz., and from other sources 421 oz., making a total of 59,616 oz., worth £270,446, or 31s. 3d. per ton. The working profit was £83,124, out of which £5089 was paid as taxes, and £11,757 was allowed for depreciation. The shareholders received £65,000, being at the rate of 20%. The development done during the year has fully maintained the ore reserve, which is sufficient to keep the mill occupied for nearly 4 years. On the 19th level the main orebody has been proved to be longer than in the levels immediately above and for nearly its whole length it contains profitable ore. A winze sunk below this level continues in satisfactory ore.

Great Boulder Perseverance.—This company was formed in 1895 to acquire a property at Kalgoorlie, West Australia. In those days Frank L. Gardner was chairman, with Zebina Lane as general manager, and large profits were made from bonanza ore. In 1904 the rich ore came to a sudden end without any public warning having been given. Subsequently the technical direction passed into the hands of Hooper, Speak & Co. Profits were continued on a smaller scale until 1909, when a fire destroyed the surface plant. Since then, the grade of the ore has been too low to permit the distribution of further dividends, except during 1912, when 2½% was paid. The report for the year 1913 shows that, owing to the method of stoping, the ore mined was of lower grade than the estimated average of the reserve. The tonnage mined was 244,841 tons, and the yield was 59,451 oz. gold, worth £253,218. The profit was £6896, which was carried forward. The reserve on December 31 was estimated at 516,978 tons averaging 25s. per ton, and in addition the probable ore was estimated at 321,280 tons averaging 21s. 4d. per ton. The reserve stands at much the same figure as a year ago. The managers state that the development at depth continues fairly satisfactory, and that there is no sign of impoverishment.

SOUTHERN PART OF WESTERN AUSTRALIA

Ivanhoe Gold Corporation.—This company was formed in 1897 by the late Whitaker Wright to acquire the property of a local company at Kalgoorlie, West Australia. Dividends have been paid continuously from 1898, the total distribution to date being £3,250,000, from a gold production of £7,494,844 extracted from 2,762,166 tons of ore. Bewick, Moreing & Co. are the consulting engineers, and R. B. Nicolson is the manager. About two years ago the developments at depth began to be disappointing. Malcolm Maclaren reported on the prospects at depth during 1913. The report for the year 1913 now published shows that no improvement has taken place at the bottom of the mine. The main shaft is down to 2953 ft., and it is to be sunk to 3170 ft. with a view of ascertaining whether the lode passes through the porphyry zone into more kindly country rock once more. The ore reserve on December 31 was estimated by Mr. Nicolson at 991,417 tons averaging 38s. 6d., being decreases of 89,433 tons and 2s. 1d. per ton as compared with the previous year. During the year, 239,314 tons of ore was raised and treated for a yield of gold worth £453,162 or 37s. 10d. per ton. The cost was £271,553 or 22s. 8d. per ton, leaving a profit of £181,609 or 15s. 2d. per ton. After the payment of taxes and allowance for depreciation the net profit was £157,910, out of which £150,000 was distributed as dividend.

Mount Bischoff Tin.—The report of this Tasmanian company for the half-year ended December 31 shows that 135,543 tons of ore was mined, and after the rejection of 12,943 tons waste, 122,601 tons was sent to the mill. The production of tin concentrate amounted to 600 tons. At the smelting works at Launceston 619 tons of concentrate was reduced for a yield of 399 tons of metal. The works also treated 1567 tons of custom concentrate, from which 1093 tons of tin was extracted. These figures are much the same as those for the two previous half-yearly periods, but owing to the fall in the price of tin, the revenue was only £68,534, as compared with £78,239 during the six months ended June 30 1913, and £87,061 during the six months ended December 31 1912. The net profits were £23,283, as compared with £33,865 and £42,845. The shareholders received £36,000, as compared with £36,000 and £39,000, the deficiency in profit being supplied out of the large balance in hand in order to maintain the dividend. The report indicates that the southern slopes are becoming exhausted and that the northern and eastern slopes are being extensively prospected. Ore from the northern slopes is to be brought to the mill during the current year for a large-scale test. The last published estimate of reserve was in 1908, when the figure was given at 2,518,000 tons, of unspecified content.

Mount Boppy Gold.—This company was formed by John Taylor & Sons in 1899 to acquire a gold mine in the Cobar district of New South Wales. The metallurgical plant of the Gallymont mine was purchased at the time of flotation. Dividends were paid regularly from 1902 to 1911. Owing to serious drought, operations were curtailed during the middle of 1912. It happened that at the time the profits were being used for the purpose of paying for the plant, consisting of tube-mills and Moore filters, provided for treating the sulphide ore, and owing to the unexpected check to production and profit, it was found necessary to issue preference shares for the purpose of liquidating this debt for the plant. The report for the year 1913 shows that 64,762 tons of ore was raised and treated in the oxide and sulphide plants, for a yield of 25,388 oz. worth £107,685. The working cost was £92,118, £1332 was paid as income tax, £5468 written off for depreciation and new issue expenses, and £1508 distributed as 10% dividend on the £30,000 preference shares of £1 each. The 121,000 ordinary shares of £1 each received nothing. During the year, 2185 ft. of development was done, and the ore reserve was well maintained at 205,387 tons, as compared with 208,597 tons the year before. As we have previously recorded, the trough formation at this mine gives rise to anxiety as to the behaviour of the orebody at depth. A diamond-drill outfit has been despatched, and extensive exploration laterally and downward is to be undertaken. James Negus is the superintendent.

Gibraltar Consolidated Gold Mines.—This company was formed by John Taylor & Sons in 1895 to acquire a gold mine in the Adelong district of New South Wales. Milling commenced in 1897. After the payment of a dividend in 1898, the results became disappointing, and reconstruction was necessary in 1900. The results since then have been unsatisfactory from the point of view of the shareholders. The report for the year 1913 shows that 6240 tons of ore was milled for a yield by amalgamation and cyanide of gold worth £25,421. The profit was £4551. Developments on the 900-ft. level in O'Brien's section have proved 250 ft. of lode averaging 28 dwt. over a width of 2 ft. 3 in. A winze has been sunk 100 ft. below this level in ore of good grade, so that the prospects here are hopeful. It is intended to introduce rock-drills so as to accelerate development at depth. Nicholas Holman is superintendent.

Nigel Gold.—This company was formed in Natal in 1887 to acquire a gold deposit near Heidelberg, about 16 miles to the south of the mines in the far east Rand. The deposit is considered to be an outcropping extension of the Main Reef Series, but the distribution of the gold is more irregular than on the Rand. Milling started in 1888, and dividends have been paid regularly except during the war. In 1910 the number of stamps was increased from 55 to 75. The report for the year 1913 shows that 158,550 tons of ore was raised, and after the rejection of 2050 tons of waste, 156,500 tons, averaging 7·38 dwt., was sent to the mill. The yield by amalgamation was 28,854 oz., and by cyanide 25,628 oz., making a total of 54,482 oz., being an extraction of 6·97 dwt. per ton. In addition, 1433 oz. was recovered from 12,150 tons of accumulated sand. The income was £239,429, and the working cost £190,518, leaving a profit of £48,911. Out of the profit, £2600 was paid as profits tax, and £12,671 written off for depreciation. The shareholders received £33,465, being at the rate of 15%. The development done during the year disclosed 182,934 tons of ore, of which 69,284 tons contained over 6 dwt. per ton. The reserve on December 31 was estimated at 96,849 tons averaging 6 dwt. and over. There is also 741,201 tons standing in the mine of too low grade to warrant extraction. The manager, L. E. De Villiers, forecasts a diminished profit for the current year. He recommends the addition of a second tube-mill and the placing of 20 stamps out of commission, the object being to grind finer and so improve the percentage of recovery in the cyanide plant.

City & Suburban.—This company was formed in 1887 under Natal laws to acquire an outcrop mine in the central part of the Rand. The technical control is with the Central Mining Corporation. Dividends were first paid in 1888. The report for the year 1913 shows that 340,240 tons of ore was raised, and after the rejection of 10% waste, 306,989 tons, averaging 38s. 4d. per ton, was sent to the mill. The yield by amalgamation was 94,480 oz., and by cyanide 44,196 oz., a total of 138,676 oz., worth £582,473, being 38s. per ton milled. A special clean-up yielded £20,961 additional gold, bringing the revenue to £603,435. The working cost was £334,954 or 21s. 10d. per ton, leaving a profit of £268,481, or 17s. 6d. per ton. Out of the profit, £5525 was paid to the Phthisis fund and £24,665 as profits tax. The shareholders received £204,000, being at the rate of 15%. Development amounting to 13,685 ft. was done during the year, disclosing 242,400 tons of Main Reef Leader and 17,100 tons of South Reef. The reserve on December 31 was estimated at 627,400 tons of Main Reef Leader averaging 8·7 dwt., and 159,100 tons of South Reef averaging 6·7 dwt. Judging by claim area, the life of the mine is about five years

New Heriot.—This company was formed in 1887 under Natal laws to acquire a small property on the outcrop in the eastern part of the central Rand between the Nourse and Jumpers. The head office is in Pietermaritzburg, and the company belongs to the same group as the City & Suburban. The technical direction is with the Central Mining Corporation. The report for the year 1913 shows that operations were seriously hindered by the flooding of the mine on November 13 following an exceptionally heavy rainfall. It was not until December 10 that part of the battery could start again, and until the end of the month that operations became normal. During the year, 156,434 tons of ore was raised, and after the rejection of 15% waste, 133,128 tons averaging 35s. 3d. was sent to the mill. The yield by amalgamation was 38,385 oz. and by cyanide 16,418 oz., a total of 54,803 oz., worth £230,729, being 34s. 7d. per ton milled. The working cost was £151,605, or 22s. 9d. per ton, leaving a profit of £79,124, or 11s. 10d. per ton. In addition, a profit of £3008 was made by the treatment of 10,763 tons of accumulated slime. The development disclosed 86,095 tons as compared with 109,822 tons the previous year. The reserve on December 31 was 581,124 tons averaging 8·1 dwt. Based on claim area, the expected life of the mine is six years.

Crown Mines.—This company was formed in 1909 to consolidate the Crown Reef, Crown Deep, Robinson Deep, Langlaagte Deep, South Rand Gold, and other properties in the central Rand, and at the present time it constitutes one of the three great consolidations on the Rand, the other two being the Randfontein Central and the East Rand Proprietary. The control is with the Rand Mines, H. Stuart Martin is consulting engineer, and R. C. Warriner is manager. The equipment contains 660 stamps and 26 tube-mills. The report for the year 1913 shows that in spite of a reduction of the labour supply after the strike in July, and the consequent decrease in the tonnage milled, the total tonnage for the year was higher by 274,900 tons as compared with 1912. The yield per ton was 2s. 5d. less and the working cost 1s. 11d. per ton lower, while the total profit was £128,226 greater. The tonnage mined during the year was 2,483,622 tons, and after the rejection of 11·8% waste, 2,195,600 tons was sent to the mill. For the first eight months the average was 190,000 tons per month, but during the last four it was only 170,000 tons. The yield of gold by amalgamation and cyanide was 772,194 oz. worth £3,248,132, being 29s. 7d. per ton milled. The working cost was £1,805,659 or 16s. 5d. per ton, leaving a profit of £1,442,473 or 13s. 2d. per ton. The sum of £63,829 was spent on capital account on development and equipment, £50,000 was paid as debenture interest, £31,183 as contribution to the Phthisis fund, £12,979 as annuity for undermining rights, and £125,942 as profits tax. The shareholders received £1,034,116, being at the rate of 110%. The development totalled 34,688 ft. and 2,008,271 tons of ore was exposed. The reserve on December 31 was estimated at 5,685,000 tons of Main Reef Leader averaging 30s. 6d. per ton, and 4,764,000 tons of South Reef averaging 26s. 6d. per ton. A new circular shaft 18 ft. diameter was commenced in May near the western boundary for the purpose of improving the ventilation. It should reach the horizon of the 13th level by the middle of the current year.

Bantjes Consolidated.—This company belongs to the Rand Mines group, and owns a property on the outcrop in the middle west Rand, between the Aurora West on the east and the Vogelstruis on the west. Milling was started originally in 1888, but the results were discouraging, and it was only in 1908 that systematic development was undertaken. A mill containing 100 stamps and 3 tube-mills started in the latter part of 1910, and the first dividend was paid a year ago. The most important orebody in this mine is the South Reef. The report for the year 1913 shows that developments have maintained the tonnage of ore reserve, but that the average content of the ore disclosed has been lower than during 1912. Altogether 19,533 ft. of development exposed 369,200 tons, averaging 5·7 dwt. per ton, of which 309,600 tons was in the South Reef and 59,600 tons in the Main Reef Leader. The total reserve on December 31 was 974,700 tons averaging 6·3 dwt. During the year, 329,137 tons of ore was raised from the mine, and together with 5856 tons from the dump, sent to the sorting station, where 10% waste was removed. The mill treated 300,440 tons, for a yield of 51,935 oz. by amalgamation and 40,796 oz. by cyanide, being a total of 92,731 oz., worth £389,274, or 25s. 11d. per ton milled. The working cost was £340,886 or 22s. 8d. per ton, leaving a profit of £48,387, or 3s. 3d. per ton. The yield per ton milled was 3s. 7d. per ton less than during 1912, owing partly to less sorting, greater width of stopes due to the introduction of machine drills, and lower grade of ore stoped. The cost per ton was 1s. 3d. less. Out of the profit, £4584 was paid as profits tax, and £37,672 was distributed as dividend, being at the rate of 7½%. W. W. Lawrie is the manager.

Meyer & Charlton.—This company belongs to the Albu group and was formed in 1888 to acquire a property on the outcrop in the central Rand. On the approaching exhaustion of the original mine in 1909, an additional 83 acres on the dip was purchased. Milling commenced in 1888 with 10 stamps, and the present equipment contains 75 stamps and 2 tube-mills. A year ago we were able to record that the year 1912 had been the best yet, both as regards output and development. As regards the year 1913, the output, profit, and ore reserve show further advances. During the year, 185,553 tons of ore was raised, and after the rejection of 7% waste, 172,552 tons averaging 10·77 dwt. was sent to the mill. The yield by amalgamation was 41,479 oz. and by cyanide 51,760 oz.; in addition 1337 oz. was recovered from accumulated slime, and 2098 oz. from concentrate. The total revenue was £422,179, and the cost £158,388, leaving a profit of £263,791. Out of this, £51,216 was paid to the government as profits tax and as share in the profits due on undermining rights. The shareholders received £140,000, being at the rate of 70%. The ore reserve on December 31 was estimated at 471,844 tons averaging 11·7 dwt. per ton. The reserve was divided among the various reefs as follows: Main Reef Leader, 207,011 tons averaging 19·9 dwt. over 46 in.; South Reef, 211,217 tons averaging 5 dwt. over 66 in.; and Main Reef, 53,616 tons averaging 6·3 dwt. over 82 in.

The total production to date has been £4,479,783 from 2,305,824 tons, and the dividends £1,295,309.

Randfontein Central.—This company was formed in 1911 to consolidate the South and Central Randfontein companies, operating under the control of Sir J. B. Robinson in the far west Rand. The report for the year 1913 shows that an average of 800 out of 1000 stamps were at work. The ore mined totalled 2,784,538 tons, and after the rejection of 9% waste 2,533,043 tons was sent to the mill. The yield of gold by amalgamation was 370,689 oz., and by cyanide 366,586 oz., a total of 737,275 oz. worth £3,103,165 being 5·82 dwt. or 24s. 6d per ton milled. The working cost was £2,182,031 or 17s 3d. per ton, leaving a profit of £921,134 or 7s. 3d. per ton. Out of the profit £210,023 has been appropriated for capital expenditure, £180,000 paid as debenture interest being 6% on an issue of £3,000,000, £56,371 as profits tax, and £49,943 as contribution to the Phthisis fund. The shareholders received £419,370, being at the rate of 10%. During the year, 91,629 ft. of development work was done. The reserve on December 31 was estimated at 6,818,929 tons averaging 6·5 dwt. per ton. There was also 1,816,681 tons averaging 3·1 dwt. which may possibly provide some blocks of ore worth extracting. C. A. Ferguson is general manager.

Langlaagte Estate & Gold Mining.—This company was formed in 1889 by J. B. Robinson to work an outcrop mine in the central part of the Rand. For some years the mine was one of the leading producers. In 1909, adjoining properties belonging to the Block B and Langlaagte Exploration companies were acquired, as the original mine was nearing exhaustion. Three years ago the developments at Block B were far from encouraging, but later development has given more satisfactory results. The report for the year 1913 shows that 635,250 tons of ore was raised, of which 417,098 tons came from the Block B and 218,152 tons from the old mine. After the rejection of 2½% waste, 620,622 tons was sent to the mill, which contains 200 stamps and 5 tube-mills. The yield of gold was 67,791 oz. by amalgamation and 92,575 oz. by cyanide, a total of 160,366 oz. worth £675,273, being 5·17 dwt. or 21s. 9d. per ton milled. The working cost was £530,390 or 17s. 1d. per ton, leaving a profit of £144,883 or 4s. 8d. per ton. Out of the profit, £34,774 was allocated to capital expenditure, £7285 was paid as profits tax, and £11,655 paid to the Phthisis fund. The shareholders received £88,650, being at the rate of 10%. During the year, development has been pushed, and the reserve on December 31 was estimated at 1,512,359 tons as compared with 1,370,639 tons the year before. The distribution of the reserve was 846,020 tons in the Main Reef, and 666,339 tons in the South Reef. The assay-value of the reserve is not given. The original mine will not provide much more ore, and what was mined during 1913 was of comparatively low grade and won at a cost higher than the average. Arrangements are in hand for gradually increasing the supply of ore from Block B as that coming from the old mine diminishes. Hugh Mitchell is the manager, having succeeded J. A. Hebbard in May last.

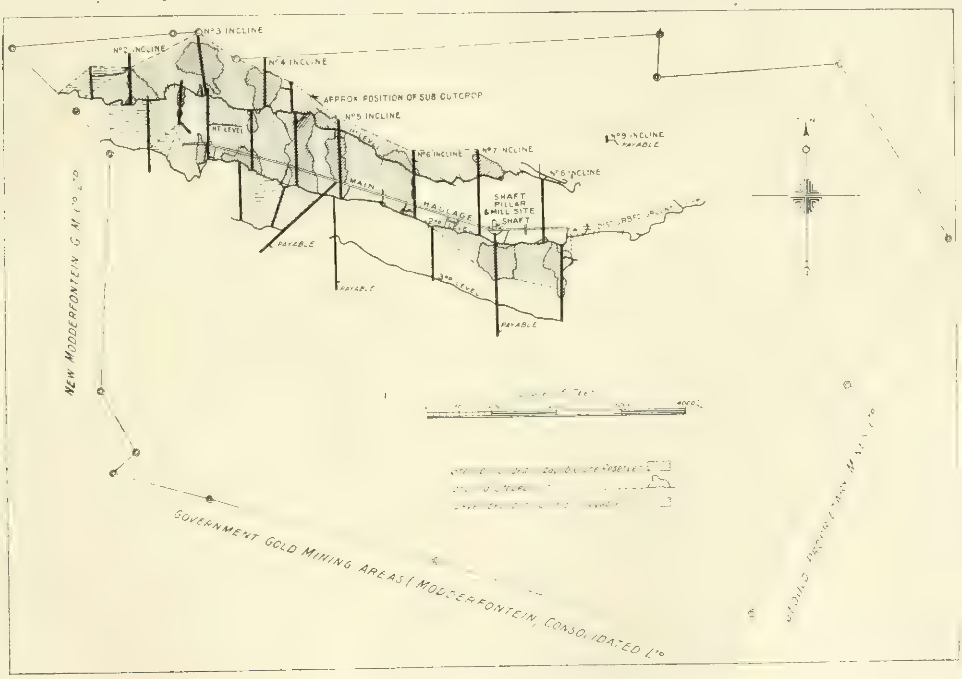
New Primrose.—This company belongs to the Barnato group and owns an outcrop property in the middle east Rand. Milling commenced in 1889. In 1912 tube-mills were first adopted, two being then installed. The mine is approaching exhaustion, and attention is being paid to reclamation of ore left standing in the upper levels. The report for the year 1913 shows that 298,212 tons was mined, of which 151,241 tons came from the old workings. This, together with 5018 tons from the dumps, was sent to the sorting station, where 8230 tons of waste was removed. The 160-stamp mill treated 295,800 tons averaging 6·76 dwt. per ton, for a yield of 70,153 oz. by amalgamation and 26,569 oz. by cyanide, a total of 96,722 oz. worth £411,702, being 6·54 dwt. or 27s. 10d. per ton milled. The working cost was £201,674 or 13s. 7d. per ton, leaving a profit of £210,028, or 14s. 3d. per ton. In addition, 10,227 tons accumulated slime yielded 1184 oz. at a profit of £3560. The profits tax absorbed £20,445, and £2883 was paid to the Phthisis fund. The shareholders received £195,000, being at the rate of 60%. The result of the adoption of tube-mills has been satisfactory, as the content of the residue has been reduced from 0·56 to 0·25 dwt. per ton. Little development at depth can now be done, but much ore still remains in the upper levels. The reserve at December 31 was estimated at 401,045 tons averaging 6·2 dwt. It is noteworthy that sorting has been gradually reduced until none is now being done. James G. Lawn is consulting engineer, and J. L. van Eyssen manager.

Ginsberg.—This company belongs to the Barnato group, and owns a property on the outcrop in the middle east Rand, immediately west of the East Rand Proprietary. The control is with the Barnato group, and Errol G. Hay is manager. Milling commenced in 1894, and dividends were paid from 1897 to 1905, except during the war. In the latter year the mill was destroyed by fire, and in 1906 the Balmoral company's plant was leased. In the following year the Ginsberg and Balmoral companies were amalgamated. The payment of dividends was resumed in 1908. In 1912 the first tube-mill was erected. The report for the year 1913 shows that 250,556 tons of ore was raised, and after the rejection of 30% waste, 176,182 tons averaging 6·9 dwt. was sent to the mill. The yield by amalgamation was 34,627 oz. and by cyanide 22,598 oz., a total of 57,225 oz. worth £243,163, being 6·5 dwt. or 27s. 7d. per ton milled. The working cost was £173,309 or 19s. 8d. per ton, leaving a profit of £69,854 or 7s. 11d. per ton. In addition, 208 oz. was recovered from 2111 tons of accumulated slime. Out of the profit, £5445 was paid as profits tax, and £2290 as contribution to the Phthisis fund. The shareholders received £73,500, being at the rate of 35%. The ore reserve on December 31 was estimated at 312,540 milling tons averaging 6 dwt. per ton.

Witwatersrand Gold.—This company owns the mine usually known as Knight's, on the outcrop in the middle east Rand west of Ginsberg and Witwatersrand Deep. The control is with the Barnato group, and F. B. Lewis is manager. Milling commenced in 1888, but was suspended from 1891 to 1896, during which years attention was centred on exploration and development. In 1910 development of the southern or deep level section was commenced with the sinking of a vertical shaft 3000 ft. from the outcrop. The report for 1913 shows that in spite of labour troubles the company enjoyed a record year. The tonnage hoisted was 526,670 tons, of which 14·8% was rejected as waste, leaving 448,680 tons averaging 6·5 dwt. per ton to be sent to the mill. The yield by amalgamation was 86,337 oz. and by cyanide 49,186 oz., a total of 135,523 oz. worth £576,431, being 6·03 dwt. or 25s. 7d. per ton milled. The working cost was £330,789 or 14s. 8d. per ton, leaving a profit of £245,652 or 10s. 11d. per ton. The sum of £5357 was paid to the Phthisis fund and £20,168 as profits tax. The shareholders received £234,812, being at the rate of 50%. The profit was greater by £37,720 than during 1912 and the assay-value of the ore milled was 0·35 dwt. higher. In October the new tube-mill plant was put into operation. The ore reserve on December 31 was estimated at 1,225,688 milling tons averaging 6·4 dwt. per ton.

Witwatersrand Deep.—This company was formed in 1895 to acquire a deep level property, below the Ginsberg, and to the west of the East Rand Proprietary Mines. The control is with the Neumann group, and E. E. Hardach is manager. David Wilkinson succeeded S. C. Thomson as consulting engineer last year. Milling was started in 1902 with stamps hired from the old Balmoral company, and shortly afterward a new plant containing 245 stamps and 4 tube-mills was erected. The first dividend was paid in 1906. The report for the year 1913 discloses several features of improvement. The tonnage raised was 573,514 tons, and after the rejection of 9·6% waste, 518,230 tons, averaging 7·19 dwt., was sent to the mill. The yield by amalgamation was 133,500 oz. and by cyanide 45,192 oz., a total of 178,693 oz., worth £750,612, being 6·89 dwt. or 28s. 11d. per ton milled. The working cost was £447,385 or 17s. 3d. per ton, and the profit £303,227 or 11s. 8d. per ton. Out of the profit, £42,490 was allocated to capital expenditure, £7860 was devoted to the extinction of debentures, £16,305 was paid as profits tax, and £8070 was contributed to the Phthisis fund. The shareholders received £192,500, being at the rate of 35%. The tonnage milled was 67,230 tons more than during 1912, the yield £119,382 greater, and the profit £98,221 higher. The yield per ton was 11d. greater and the cost per ton 1s. 8d. less, so that the profit per ton was 2s. 7d. per ton higher. Owing to more pumping being done at the East Rand Proprietary, the water dike is yielding less water in the Witwatersrand Deep, so that development can now be more readily effected below the dike. The development done in this section during the year was all in profitable ore. The reserve on December 31 was estimated at 1,666,000 tons averaging 6·8 dwt., an increase of 173,700 as compared with the year before. Sand-filling has been adopted on the plan described in Précis of Technology this month. By its means a large amount of ore has been reclaimed from the upper levels. The capacity of the mill has been raised to 52,000 tons per month by the addition of a fifth tube-mill and a number of slime vats.

Modderfontein B. Gold Mines.—This company was formed in 1908 by the Rand Mines group to develop property in the far east Rand, to the east of the New Modderfontein. The banket does not outcrop, as it is covered by beds belonging to the Karroo age. The dip is not more than 14°. Development has been done by coal-mining methods under the advice of H. Stuart Martin, and mechanical haulage has been adopted, thus greatly decreasing the number of natives employed.



PLAN OF WORKINGS, MODDERFONTEIN B.

Milling commenced in September 1911 with 80 stamps and 5 tube-mills, and the first dividend was paid a year ago. The report for the year 1913 shows that 447,614 tons was raised from the mine, and this, together with 9144 tons from the dumps, was sent to the sorting station. After the rejection of 11% waste, 404,580 tons averaging 39s. 11d. was sent to the mill. The yield by amalgamation was 103,537 oz. and by cyanide 82,984oz., a total of 186,521 oz., worth £784,428, or 38s. 9d. per ton milled. The working cost was £330,897 or 16s. 4d. per ton, leaving a profit of £453,530 or 22s. 5d. per ton. Out of the profits, £25,723 was devoted to expenditure on additional cyanide plant and housing accommodation. As compared with the previous year, the tonnage milled showed an increase of 16,010 tons milled, an increase of 1s. 5d. per ton in the yield, a decrease of 1s. 4d. per ton in the working cost, and a greater profit by £71,377. Taxes absorbed £43,800, and the shareholders received £315,000, being at the rate of 45%. Development has been centred on the richer ground to the west and south of the main shaft, and the reserve has been increased by 585,081 tons averaging 12½ dwt. per ton. The total reserve on December 31 was estimated at 2,800,400 tons, averaging 8 3 dwt. or 34s. 10d. over 55 in. In addition, 389,600 tons averaging 3·9 dwt. per ton has been developed. The object of developing richer ground was to place the reserve in a satisfactory position at as early a date as possible, as the eastern section of the deposit, being faulted and of irregular content, will present many difficulties in development. One important piece of development has, however, been done in the eastern section, by a winze sunk from an old prospecting shaft, the result being the disclosure of banket 16 in. wide averaging 20 dwt. per ton, for a distance of 200 ft. This winze is to be continued, and should help to interpret the geology of the disturbed ground. The system of waste-packing underground has been continued successfully, at a cost of 10d. per ton milled, and there have been no stoppages or delays due to crushing of the hanging wall. The metallurgical plant is being increased by 16 Nissen stamps and 1 tube-mill, and with August the capacity should be 40,000 tons per month. The labour trouble of July last caused a temporary stoppage, but little subsequent inconvenience.

New Kleinfontein.—This company belongs to the Anglo-French group, and was formed in 1893 to acquire an outcrop property in the far east Rand. Edward J. Way was for many years until recently the consulting engineer, and as an old opponent of tube-mills did not install any until 1912. The report for the year 1913 shows that 656,963 tons of ore was raised, and after the rejection of 17% waste, 540,300 tons averaging 6·9 dwt. per ton was sent to the mill. The yield by amalgamation was 116,051 oz. and by cyanide 60,706 oz., a total of 176,757 oz., worth £751,379, being 27s. 9d. or 6·54 dwt. per ton milled. The working cost was £511,316 or 19s. 3d. per ton, leaving a profit of £231,523 or 8s. 6d. per ton. Owing to labour troubles, the mill was idle for 7 weeks, and the output suffered by 65,000 tons. Out of the profit, £99,000 was devoted to reducing the debt to the bank from £174,000 to £75,000. This debt was incurred in 1910 for the purpose of developing the Orient section then acquired. There was spent during the year £17,077 out of revenue on capital account, particularly for shaft-sinking, and £72,750 was distributed as dividend, being at the rate of 7½%. The ore reserve on December 31 was estimated at 1,658,481 tons averaging 6·3 dwt. over 59 in. Developments in the Eastern and Central sections have been generally satisfactory. Mr. Way estimates the ultimate life of the mine at 12 years. Since the period covered by the report, arrangements have been made to consolidate with the Apex and Benoni companies, on terms given elsewhere in our pages. E. H. Bulman is manager.

North Star Mines.—This company has operated a gold mine in Grass Valley, California, for thirty years. During this time, 1,062,872 tons of ore has been raised, yielding gold worth $14,090,612, or $13·25 per ton. The dividends have aggregated $4,087,040, being 143% on the capitalization, $2,500,000. The report for the year 1913 shows that 112,110 tons was mined, and after the rejection of 6020 tons waste, 106,090 tons was sent to the mill. The yield by amalgamation was $938,262, and $261,834 by cyanide ($71,090 from concentrate and $190,744 from mill tailing) being a total of $1,200,096, or $11·31 per ton milled. The working cost including development was $551,997, or $5·20 per ton. The dividend absorbed $300,000, being at the rate of 12%. The ore mined during the year came chiefly from the 3400, 3700, and 4000-ft. levels. As compared with the previous year, the yield was $1·05 per ton greater and the cost 32 cents less. During the year, the levels at 5000 and 5300 ft. have been driven and rises cut above them. This work resulted in the development of large blocks of ore, sufficient to supply the mill for several years. The main shaft has been sunk to 5850 ft., or 2200 ft. vertically, and a level is being opened at 5600 ft. During the year, the option on the Champion mine and its 40-stamp mill was exercised. Arthur B. Foote was appointed manager for the company in succession to his father, Arthur De Wint Foote, who had been in charge since 1896.

Seneca Superior Silver Mines.—This company was formed in 1912, under Canadian laws, to acquire leases of ground below Peterson and Cart lakes at Cobalt, Ontario, previously held by the Kerry Mining Co. Operations have so far been confined to the Cart lake lease. S. H. Worth is president, W. E. Segsworth is consulting engineer, and R. H. Lyman is manager. The report for the 11 months ended December 31 last does not give particulars of the ore mined, but states that 1,085,774 oz silver was produced, and that the profit was $286,626, out of which the shareholders received $263,136 as dividend. Mr. Segsworth states that the Worth vein has been developed on four levels in high-grade ore. On the first level, at 92 ft., spectacular ore has been found. On the 2nd level, the ore-shoot is 440 ft. long averaging 3500 oz. silver over 3 in. The 3rd level, at 262 ft., has been driven 280 ft., and the vein averages 2300 oz. over 2½ in. On the 4th level, at 334 ft., for the 220 ft. driven the vein averages 1·2 in. assaying 960 oz. silver per ton. During the year the ore reserve has been increased from 1,150,000 oz. silver content to 3,460,000 oz. silver.

Waihi Gold.—The report for 1913 of this company, owning the great gold mine in New Zealand, affords disappointing reading as regards the developments. The impoverishment that commenced three years ago on the 9th level is still the regrettable feature of the mine-workings. Developments on the Martha lode have been uniformly unsatisfactory on the 10th level. Some ore has been found on the Empire and Royal lodes. Between the two latter a new lode has been discovered, and it has been developed on the 8th, 9th, 10th, and 11th levels. It is small on the 8th level, and rather larger on the 9th; on the 10th the ore-shoot is 730 ft. long and from 2 to 5 ft. wide, varying greatly in content, but averaging about 45s. per ton in gold and silver. Prospecting has been done in the upper levels on a number of small veins that were formerly of little importance, and several blocks of ore have been proved. The ore reserve on December 31 was estimated at 764,732 tons as compared with 750,634 tons the year before, in neither case the gold content being specified. During the year, 184,768 short tons was raised, of which 69,437 tons came from the Martha lode, 38,556 tons from the Royal, 28,502 tons from the Edward, and 27,451 tons from the Empire, in all cases chiefly from the 8th and 9th levels. The milling was done almost entirely at the Victoria plant, where 123 stamps and 7 tube-mills were running, out of 200 stamps and 11 tube-mills. The assay-value of the ore delivered to the stamps was 8·3 dwt. gold and 2 oz. 16 dwt. silver per ton. The yield of bullion was worth £336,651, and the working cost was £211,394, leaving a working profit of £140,743. Out of the profit, £24,057 was written off for depreciation, and £22,487 paid as taxes. The shareholders received £99,181, being at the rate of 20%. The results look small as compared with those of 1909, when bullion worth £926,100 was recovered from 442,020 tons and £485,161 distributed as dividend. Since the commencement in 1890, the yield has been £10,454,869 and the dividends £4,865,307.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Managing Director.

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CONTENTS.

STATISTICS.

STOCKS OF COPPER IN ENGLAND AND THE CONTINENT.
Reported by Henry R. Merton & Co. Tons of 2240 lb.

	Mar. 31 Tons	April 30 Tons	May 31 Tons
In England	9,948	11,519	12,684
In France	1,791	2,310	5,934
Afloat from Chile	2,350	2,500	1,700
Afloat from Australia	3,800	4,000	4,000
In Rotterdam	3,200	3,400	3,100
In Hamburg	3,947	4,452	3,872
In Bremen	1,093	1,097	1,080
In other European Ports	600	575	600
Total European visible supply	26,729	29,853	32,970

AMERICAN COPPER PRODUCERS' ASSOCIATION'S FIGURES.
In Tons of 2240 lb.

	Production.	Deliveries			Stocks at end of month
		Domestic	Foreign	Total	
Total, 1911	639,258	316,791	337,009	653,800	—
Total, 1912	706,052	365,920	333,212	699,132	—
April 1913	60,416	34,892	38,346	73,238	33,728
May	63,088	36,209	30,477	66,686	30,130
June	54,402	30,559	30,396	60,955	23,577
July	61,649	26,296	35,035	61,331	23,886
August	58,764	32,897	32,706	65,603	17,064
September	58,661	29,837	32,627	62,464	13,261
October	62,085	30,435	30,412	60,847	14,499
November	59,860	21,721	31,280	53,001	21,358
December	62,049	9,794	32,831	42,625	40,782
Total 1913	724,307	342,566	387,974	730,540	—
January 1914	58,826	21,409	39,266	60,675	38,933
February	54,715	21,244	37,455	58,699	34,949
March	65,023	31,184	39,983	71,167	28,805
April	67,634	28,315	36,761	65,076	31,363
May	63,530	24,818	32,460	57,278	37,615

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand	Elsewhere	Total	Value
	Oz.	Oz.	Oz.	£
Year 1912	8,753,563	370,731	9,124,299	38,757,560
April 1913	755,858	29,116	784,974	3,334,358
May	761,349	32,957	794,306	3,373,998
June	716,267	30,810	747,077	3,173,382
July	625,107	30,282	655,389	2,783,917
August	697,686	30,410	728,096	3,092,754
September	676,411	29,775	706,186	2,999,686
October	687,515	30,916	718,431	3,051,701
November	644,320	29,166	673,486	2,860,788
December	642,786	30,029	672,815	2,857,938
Year 1913	8,430,998	363,826	8,794,824	37,358,040
January 1914	621,902	29,851	651,753	2,768,470
February	597,545	28,716	626,261	2,660,186
March	657,708	29,093	686,801	2,917,346
April	655,607	28,270	683,877	2,904,924
May	689,259	30,970	720,229	3,059,340

COST AND PROFIT ON THE RAND.

	Tons milled	Yield per ton	Cost per ton	Profit per ton	Total profit
		s. d.	s. d.	s. d.	£
Year 1912	25,486,361	29 2	19 3	9 11	12,678,095
Year 1913	25,628,432	27 9	17 11	9 6	12,189,105
January 1914	1,902,733	27 4	18 2	9 3	876,577
February	1,861,442	26 10	17 11	8 10	823,654
March	2,094,098	26 4	17 3	9 1	945,000
April	2,075,561	26 6	17 3	9 3	955,600

GOLD OUTPUT OF INDIA.

Year 1912	Year 1913	May 1914	Year 1914
£2,265,094	£2,299,315	£193,031	£952,729

PRODUCTION OF GOLD IN WEST AFRICA.

Year 1911 £	Year 1912 £	Year 1913 £	April 1914 £	Year 1914 £
1,069,442	1,497,179	1,634,700	32,063	131,697

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold mines	Coal mines	Diamond mines	Total
April 30, 1913	205,424	9,053	15,626	230,103
May 31	197,644	9,062	15,345	222,051
June 30	188,094	9,060	14,654	211,808
July 31	170,242	9,403	13,378	193,023
August 31	158,223	9,236	13,172	180,631
September 30	152,637	9,361	12,321	174,319
October 31	148,882	9,377	12,712	170,971
November 30	147,569	9,286	12,680	169,535
December 31	150,012	9,516	11,811	171,339
January 31, 1914	154,202	9,471	11,979	175,652
February 28	157,673	9,508	12,266	179,447
March 31	162,815	9,619	13,390	185,824
April 30	165,005	9,625	14,150	188,780
May 31	165,433	9,619	14,284	189,336

PRODUCTION OF GOLD IN RHODESIA.

Year 1911 £	Year 1912 £	Year 1913 £	April 1914 £	Year 1914 £
2,647,894	2,707,368	2,903,267	295,907	1,078,063

PRODUCTION OF GOLD IN WESTERN AUSTRALIA.

	Export oz.	Mint oz.	Total oz.	Total value £
Total, 1910	363,496	1,209,856	1,573,352	6,682,042
Total, 1911	160,021	1,210,447	1,370,468	5,823,522
Total, 1912	83,589	1,199,080	1,282,669	5,449,057
Total, 1913	86,255	1,227,888	1,314,143	5,448,332
January, 1914	9,762	102,261	112,023	475,840
February	8,493	94,812	103,305	438,809
March	1,173	91,446	92,619	393,418
April	8,774	90,233	99,007	420,553
May	7,138	99,068	106,206	451,132

OTHER AUSTRALASIAN GOLD PRODUCTION.

	1912	1913	May 1914	1914
	£		£	
Victoria	2,039,400	1,847,400	133,700*	566,700*
Queensland	1,484,160	1,118,610	79,040*	303,080*
New South Wales	702,129	635,703	25,459	213,423
New Zealand	1,345,115	1,345,131	125,566	556,707

* April figures only.

NIGERIAN TIN PRODUCTION.
In tons of concentrate of unspecified content.

Year 1912 tons	Year 1913 tons	April 1914 tons	Year 1914 tons
2,532	5,032	482	1956

PRODUCTION OF TIN IN FEDERATED MALAY STATES.
Estimated at 70% of concentrate shipped to smelters.

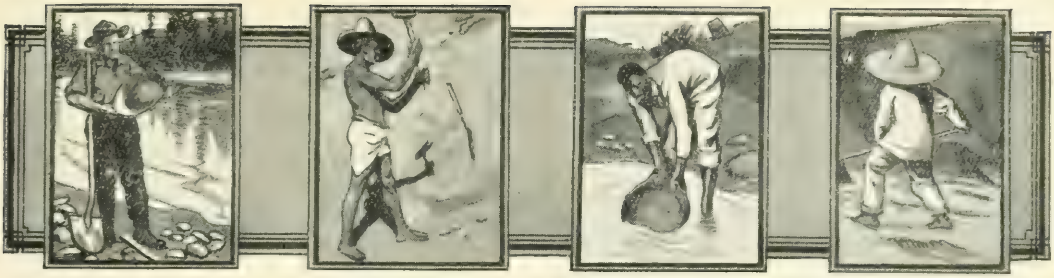
1911 tons	1912 tons	1913 tons	April 1914 tons	Year 1914 tons
43,967	48,250	50,128	4,087	16,464

SALE OF TIN CONCENTRATE AT REDRUTH TICKETINGS.

	Tons	Value	Average
Year 1911	6151¼	£702,599	£114 4 5
Year 1912	6492	£831,908	£128 5 6
Year 1913	6186	£744,268	£120 2 6
January 5, 1914	202¼	£18,743	£92 13 6
January 19	232¼	£23,045	£96 6 6
February 2	231	£24,054	£104 2 7
February 16	232¼	£23,824	£102 11 7
March 2	234¼	£22,286	£95 2 9
March 16	214½	£20,726	£96 12 6
March 30	229½	£21,776	£94 17 8
April 14	193½	£18,251	£94 6 5
April 27	220½	£19,413	£88 0 11
May 11	215½	£18,485	£85 15 6
May 25	227½	£19,155	£84 4 0

EXPORTS OF TIN AND ORE FROM STRAITS AND BOLIVIA.
Reported by A. Strauss & Co.

	1912 tons	1913 tons	May 1914 tons	1914 tons
Metal from Straits to Europe and America	59,036	62,533	6,863	27,716
Metallic Content from Bolivia to Europe	21,149	24,843	1,840	10,594



REVIEW·OF·MINING

INTRODUCTORY.—The period since we last went to press has been one of acute anxiety, culminating in two failures, which to a large extent have cleared the air of rumours and relieved the tension of the past five weeks. The two political factors, in Ulster and Mexico, remain a menace, but mediation is at work in both cases, not without hope. London, however, has been called upon to carry heavy responsibilities, for New York, St. Petersburg, and Paris, in turn, have been in difficulty. Increase in railway rates and bumper crops are likely to relieve the American money market. The excesses of Russian speculators have led to some realization on Siberian mining shares, which have been absorbed by English purchasers. The strain on the other continental bourses has been relieved by the formation of the Ribot cabinet. But the mining market has passed through the crisis with comparatively little hurt. The South African department is likely to be cheered by the forthcoming half-yearly dividends from the Rand and by the increasing output of gold in Rhodesia, due, of course, to newly contributing companies. Further underground developments at the South mine have given a good tone to Broken Hill shares, in spite of the weak market for silver and zinc. Depression in the tin market is affecting the mining for that metal in Cornwall, Nigeria, and the Malay States. The steadiness of copper is a good feature.

TRANSVAAL.—The gold and labour statistics for May are satisfactory. An increase of 36,352 ounces, equal to £154,416, is recorded. The increase in natives employed is 438, which compares with a decrease of 7780 during the corresponding month of last year. The supply, however, is still inadequate, being 165,433 as against 197,644 a year ago.

Our Johannesburg correspondent refers guardedly to the possibility of the disappearance of one or two of the Rand houses not at present in strong financial positions, or of the provision of capital and assumption of technical control of the properties by a more prosperous firm. He is of opinion that such an event will form a practical step toward the unification of operations throughout the Rand.

The ore so far disclosed below the great dike at Knight Central is proving disappointing. Sampling along 720 feet shows 195 feet to contain ore averaging 7·1 dwt. over 61 inches and the remainder averages only 1·9 pennyweights.

The figures for development work at Modderfontein B during the first quarter of the year showed a decrease in grade that has puzzled some people. It is opportune to say that in some levels in the western section ore of high content has been found, whereas in the eastern part now being developed, the ground is much broken, and, indeed, the geology is difficult to unravel. The policy has been to accumulate a large reserve of high-grade ore to equalize the uncertainties of the faulted parts. It is probable therefore that in future lower returns will be made from the developments. The metallurgical plant is being enlarged by the addition of 16 Nissen stamps and a tube-mill, and on the completion of this equipment in August, the output will be raised to 40,000 tons per month.

At the annual meetings of the General Mining & Finance Corporation and its subsidiaries, Sir George Albu exhibited as cheerful a spirit as was possible under the circumstances. Following a depreciation of £281,292 in the parent company's investments in 1911, and one of £57,842 in 1912, he had to announce a depreciation of no less than £833,236 for 1913. Moreover, the company is saddled with loans to its subsidiaries amounting to £602,884, debts which it is impossible to capitalize at present. The money thus advanced appears to have been borrowed, for on the opposite side of the balance sheet is the item: Sundry creditors, £765,786. Of individual members of the group, the Meyer & Charlton is doing brilliantly, and the Van Ryn is performing creditably. The West Rand Consolidated shows some improvement. On the other hand, Cinderella, Rand Collieries, and Steyn Estate are idle, awaiting the provision of more capital. Roodepoort United is giving disappointing results, and Aurora West and New Goch are making only a nominal profit. During the last month or so the developments at New Goch have been much more encouraging, so much so that a resumption of dividends at an early date is contemplated.

Further capital is being supplied by A. Goerz & Co. for the Geduld, 47,500 shares having been purchased by the controlling firm at 25 shillings per share. This money will be ready for the extension of development and for increase of the mill at any time the labour supply is adequate.

An inspection has been made of the Messina mine by Mr. R. J. Frecheville, one of the directors, who reports that the proved ore down to the 9th level amounts to 247,000 tons averaging 9 per cent copper. In addition, 130,000 tons of probable ore down to the same level is estimated. No. 5 shaft has been sunk to the 10th level at 1000 feet, and a cross-cut has intersected the foot-wall branch of the Bonanza orebody. The width of the lode is 3 feet and the average assay 8 per cent. One of the results of the Grenfell collapse has been the transfer of control in this mine, by the resignation of Messrs. A. M. Grenfell and J. S. P. Samborne, followed by the election as directors of Messrs. C. F. H. Leslie and H. C. Hoover. Mr. Leslie, who is chairman of the Kyshtim Corporation, becomes also chairman of the Messina. The mine is burdened by a load of debentures of an undesirable kind, for which the Camp Bird company subscribed largely, in consideration of a further option to take more.

RHODESIA.—The output of gold continues to increase; during April it was worth £295,907, an advance of £22,700 on that of March, and comparing with £241,098 a year ago. The yield at the Cam & Motor was £24,574, and that at Shamva £27,401, these two new producers accounting for most of the increase. The returns give the tonnage treated at Shamva as 39,012, and the extraction per ton 14 shillings; the cost is given as £16,201 or 8s. 3d. per ton, but no definition of the word 'cost' is vouchsafed. The percentage of recovery at the Cam & Motor continues low, being only 57 per cent.

WEST AFRICA.—The output of the West African gold mines for April was worth £131,697, a figure a trifle higher than that for March, but £15,000 less than for April a year ago. Prestea Block A showed a gain, as also did Broomassie and the Offin River Dredging, but Ashanti Gold Fields exhibited a decline. The Prestea Block A now publishes particulars of development. During March the 7th level has given good results, the 70 feet driven having disclosed ore averaging 45s. 4d. over 14 feet.

Since Mr. J. J. Hunter, six months ago, undertook the management of the property of the Tin Fields of Northern Nigeria, on the

Fedderi river in the Ninkada district, he has conducted systematic exploration by pits and bore-holes. He reports that he has proved a strip of ground 3 miles long, 100 feet wide, and 16 feet deep, averaging 3 pounds of cassiterite per cubic yard. As funds allow, further prospecting will be done on the Lower Fedderi river.

During May, the Jos dredge recovered 27½ tons of tin concentrate from 15,200 cubic yards in a running time of 491 hours.

AUSTRALIA.—Our Melbourne correspondent appeals to the victors in the flotation litigation to use their monopoly wisely. The Labour party in the Commonwealth considers that all monopolies should belong to the State, and it is possible that a proposition may be made for the purchase of the patents, as was the case in connection with the cyanide process.

Two years ago it was known that the orebody of the Great Boulder Proprietary was showing signs of exhaustion at depth, and though the reserve of ore of average grade was sufficient to last for three or four years it was felt that the end was within sight. Nevertheless, Mr. Richard Hamilton has maintained the reserve both in tonnage and assay-value. The two shafts are now down to 2800 feet, and diamond-drilling is to be extended for 350 feet below this level. It was rumoured that the company had abandoned its option on the Stawell mine in Victoria, but Mr. Hamilton states that though the results have not yet come up to expectation, the exploratory work is being continued with the object of testing a certain part of the ground that is of some promise.

After an interval of three years the Golden Horse-Shoe has returned to the list of dividend-payers, £60,000 being distributed, partly out of the profits for 1913 and partly from the balance brought forward from 1912. For eleven years to 1909, the yearly dividend was remarkably uniform, averaging £250,000. The ore reserve has been maintained during 1913 at about 715,000 long tons assaying 8 dwt. per ton. The main shaft is down to 2836 feet, and cross-cuts have been driven to connect with the main shaft of the Great Boulder, improving the ventilation of both mines.

Operations at Great Cobar are confined to stope-filling, undertaken with a view to rendering the workings safe. No scheme has yet been evolved for providing the funds necessary for re-opening the mine.

An announcement has been made of a discovery of alluvial gold near Nullagine in the Pilbara district of West Australia. Details are scanty.

CANADA.—Further Ontario flotations may be expected shortly ; they are likely to be of the Burnside and Blue Bells class : mere prospects over-capitalized on the strength of the Tough-Oakes developments, themselves excellent, but persistently exaggerated.

The prospectus of the Blue Bells Gold Mines, Limited, giving particulars of a highly speculative venture in Northern Ontario, is intended to interest a public that we thought had ceased to exist many years ago. A half-dozen rich samples prove nothing, even if "the original certificates of the above assays are in the possession of the company, and can be inspected during business hours." Assays, no matter how accurately made, cannot be considered as evidence of a valuable mine without full particulars as to where and how the samples were secured.

As previously recorded, the Dome mine at Porcupine is to be worked as a large low-grade proposition. Mr. W. W. Mein, the consulting engineer, reports the present reserve at over 2½ million tons averaging $3·80 per ton. A year ago the figures were 650,000 tons averaging $7·50 per ton. The plant, when the extensions are completed, will have 80 stamps and 5 tube-mills. The tailing from the amalgamating plates will be separated into sand and slime instead of being all-slimed as at present.

The Mond Nickel Company is abolishing the vendor's deferred shares in exchange for 450,000 ordinary shares of £1 each. At the same time, the £5 cumulative preference shares are to be split into five of £1 each, and the holders of the 300,000 ordinary shares of £1 each are to be given instead 300,000 non-cumulative preference shares of £1 each and 450,000 ordinary shares of £1 each. During the last few years the business of this company has advanced rapidly, and the shares have been greatly in demand. A number of new properties in the Sudbury district have been recently acquired. In particular, the Levack No. 1 has been proved to contain a large body of nickel-copper ore of high grade.

UNITED STATES.—Our San Francisco correspondent describes at some length the present position of the borax industry of California, telling how potassium chloride in the deposits alters their economic position, and setting forth the relative positions of the Borax Consolidated and the Trona Corporation, the the latter of which is under the control of the Consolidated Gold Fields of South Africa. This information is opportune, seeing that a large block of Mr. F. M. Smith's shares is being offered for sale in London.

The Chisana placers in Alaska, of which so much was heard a year ago, are not doing as well as anticipated. Only the original properties staked are producing gold, and prospecting in adjacent creeks has given negative results. It is generally believed that Chisana will never become one of the celebrated districts of Alaska.

MEXICO.—Mining news remains at a discount, pending the restoration of order. The efforts of the South American governments, with that at Washington, to arrive at a solution of the impasse, have led to the meeting of mediators, at Niagara Falls, but the failure of the Carrancistas to participate in the negotiations may render them abortive. Meanwhile, some re-commencement of mining has been made in the North, by American companies, largely to placate local sentiment.

The Esperanza company is taking steps to strengthen its vitality by re-opening the adjoining Sirio and Suceso claims, at El Oro, and by participation in Siberian copper mining. Mr. R. M. Geppert has become joint consulting engineer with his partner, Mr. H. A. Titcomb. The mine and plant at El Oro remain uninjured, despite the cessation of work, due to the revolution.

RUSSIA.—The Russian copper syndicate reports the production for 1913 throughout the empire at 33,000 long tons, as compared with 33,270 tons in 1912. The production for 1914 is estimated at 40,000 tons, of which about 10,000 tons will come from Kyshtim and 5000 tons from Spassky. The consumption in Russia is greater than the home production, and 6000 tons was imported during 1913. The Atbasar and Tanalyk are prospective new producers.

Developments at the Tanalyk are unusally good, especially at the Semeonovsky mine. There, as we have previously chronicled, the gossan of an orebody 600 feet long, 40 feet wide, assaying 12 dwt. gold, has been exposed. Now boreholes are being sunk to reach the unoxidized ore. So far one bore has cut through 138 feet of lode, containing two widths of promising mineral. This is at a depth of about 300 feet, which is about 200 feet short of the lower limit of the leached zone, below which higher copper contents are reasonably anticipated. On the Idylbaeff property, three miles north, a similar orebody has been discovered, a prospecting pit penetrating gossan assaying 10 dwt. gold per ton. Cyanide tests of a satisfactory kind have been made. The smelter is treating over 100 tons per day, and satisfactory returns will shortly be published.

At the Ridder, a bore is to be sunk 120 feet north of the ground already tested. Mr. H. H. Knox, of New York, has been engaged to make a special examination of the property.

The Lena Goldfields reports the production of gold during the winter season October 1, 1913, to May 10, 1914, at 48,734 oz. from 99,022 cubic yards washed. During the same time 505,353 cubic yards of gravel was mined and hoisted. The Pokrovsky dredge belonging to the Orsk Goldfields started the summer season on April 28 and the same company's Kolchan dredge on May 1.

INDIA.—At the North Anantapur, the manager, Mr. L. C. Oliver, estimates the reserve at 51,000 tons, an increase during nine months of 7000 tons. He does not give the average assay-value, but remarks that the ore recently developed is of more than average grade. Shortness of labour restricted the development. The ore treated in the mill during the past month averaged 9·7 dwt. per ton, and 7·9 dwt. was recovered by amalgamation. The residue after cyanide treatment averaged 0·6 dwt. A tube-mill is to be erected.

In spite of shortage of hydro-electric power due to drought, the Kolar mines have maintained their output during June. The old steam-engines have been requisitioned, and, wherever circumstances justified, power has been transferred from development. Rain has fallen, but not yet in sufficient quantity to restore the normal water-level at the Cauvery Falls.

OIL.—The purchase of the control of the Anglo-Persian Oil company by the British Government has drawn attention to an oilfield amply prospected but little developed. Fifteen years ago Mr. W. K. D'Arcy, whose fortune was made by the Mount Morgan mine, acquired the sole licence for prospecting for oil throughout Persia. For some years the efforts of the drillers were unrewarded, but later the pitch accumulations east of Shustar attracted their attention, and in 1908 wells sunk to 1100 feet proved the existence of large amounts of oil in limestone beds belonging to Miocene age. This district has been called Maidan-I-Naphtun. A pipe-line 145 miles long has been built to Abadan on the Tigris, where a refinery has been erected. Owing to lack of a suitable market, many of the wells have been capped. Our Government has subscribed £2,200,000, taking 2,000,000 shares and £200,000 debentures. The present capacity of the pipe-line and refinery is about 350,000 tons per year. The oil is heavy, and after the removal of 30% of lighter constituents, the remaining 70% is suitable for steam-raising purposes. The British Government has by this policy secured a regular supply of oil-fuel for the Admiralty. This policy will be expanded wherever opportunity offers in other parts of the world, so that many alternative sources of supply shall be available. It is obvious that too much reliance should not be placed on the Persian oilfield, which, though undoubtedly rich, is within measurable distance of hostile political influence.

The oil boom in the Calgary district of Alberta continues on its frantic career. The Dingman oil-well, 36 miles to the south of the town, has given a more solid basis for excitement than the seepages on which the boom was originally founded. So much of the alleged information is provided by the large and small holders of land, from the Canadian Pacific Railway downward, that the news items are unreliable. The actual facts will not be known until Mr. Cunningham Craig's report is published. We note with pleasure that the government of Manitoba, the adjoining province, has prohibited the sale of shares in the multitudinous oil companies, unless each company can produce some guarantee of financial stability and the ownership of property of value.

Caspian oil shares have been depressed by a slump in Spies Petroleum due to water breaking into the new well at South Baskakoff, in the Grosny oilfield. This flowing well had to be plugged, and the mishap will retard the completion of three neighbouring wells belonging to the same company.

VARIOUS.—The progress of re-opening the Porco group of tin mines in Bolivia is described in a report issued by the consulting engineer, Mr. Malcolm Roberts. It has not been possible yet to prove the main lodes in depth, but at the Santa Rosa an intermediate level has disclosed ore of 4% grade. The reserve is estimated at 50,000 tons averaging 5% tin. The new mill, having a capacity of 80 tons per day, should be at work by the end of the year. In three months, the new pipeline is expected to be ready and ample power will then be available. The Porco mines were introduced in this country in 1912 by the controllers of the Aramayo-Francke properties.

The contract for the dredge for the Nechi property in Colombia has been given by the Oroville company to Fraser & Chalmers. This dredge will be of steel throughout, and electrically driven; it will be operated on spuds, and the close-connected buckets are to be of $7\frac{1}{2}$ cubic feet capacity. Dredging can be conducted to a depth of 55 feet below water-level. The weight when fully equipped will be 900 tons.

The Siamese Tin Syndicate, operating near Renong, announces that No. 2 dredge started for a trial run on May 19, and that the hull of No. 3 dredge has been floated. The latest fortnightly return shows that No. 1 dredge recovered 13 tons of concentrate from 21,000 cubic yards of material treated.

The Malayan Tin Dredging company, working in the Kinta valley, Perak, reports that No. 1 and No. 2 dredges treated 100,500 cubic yards during May for a yield of 31 tons of concentrate. Most of this was won by No. 1 dredge, as No. 2 has only just been floated. No. 3 is in course of erection, and No. 4 is being shipped from England.

The dredge of the Portuguese and American Tin Company at Gaia, Portugal, was started at the end of April. The control of the company is with Mr. E. de Sabla of San Francisco. The dredge presents several features new in connection with tin. The tables have an area of 3000 square feet, and are fitted with Venetian riffles. The clean-up is done every 12 hours, and the concentrate is treated in jigs and classifiers on board the dredge.

Additional capital to the extent of £30,000 is to be raised by the Ouro Preto Gold Mines of Brazil, with the object of expanding the scale of operations at the Passagem mine. The monthly capacity is to be raised from 6500 to 10,000 tons. To effect this a new inclined shaft will be necessary, and additional hoisting, air-compressing, and metallurgical plant is to be provided. During the past year, the ore treated was a pennyweight lower, at 7 dwt. per ton, as compared with previous years, and operations were hampered by the scanty supply of labour. The recommendations for the reorganization of work have been made by Mr. Thomas Richards, in consultation with the superintendent, Mr. A J. Bensusan. The money is to be raised by reconstruction of the company, the present ordinary shares being written down from £100,000 to £15,000, and the 36,634 preference shares being altered as to two-thirds to ordinaries. A new issue of 30,000 preference shares is to be made.

A message from the manager of the Socorro gold and silver mine, in Honduras, states that the mill and cyanide plant is at work and is giving satisfactory results. In a recent issue we did not give proper credit to the manager, Mr. J. E. Breakell, for the design and erection of the metallurgical installation.

The Sopa Diamond Company, one of Mr. Edmund Davis's ventures, is to be liquidated, as the ground is too poor and restricted in extent to provide a profit. The mine is in Minas Geraes, in Brazil, and during three months work last year 62,500 loads yielded only 127 carats, worth £910, giving a return of only $3\frac{1}{2}$d. per load. Tests with a small plant have since been made on other parts of the property, but nothing worth working was found.

EDITORIAL

AMONG those lost on the *Empress of Ireland* was Alfred E. Barlow, lately president of the Canadian Mining Institute. As an explorer, geologist, and public man he had played a notable part. We mourn the loss of a strong personality and a useful citizen.

THE temper of the workmen at Rio Tinto is still dangerous, judging from the attempt on the life of Mr. W. J. Browning, the manager, on June 1. We are glad to state that the bullet went wide of its mark.

PHILIPPINE DREDGES is the name of a company that advertises the fact of rejecting black sand assaying 150 ounces of gold per ton, this common product of dredging operations being dispersed with the tailing. Evidently the members of the staff do not read the technical press. Such kindergarten stupidity is inexcusable.

SELDOM does the tenure of an editorship, commencing with the foundation of a periodical, extend without a break for fifty years. It is of more than passing interest therefore to record that Mr. Henry Woodward, one of our leading geologists and formerly in charge of his department at the British Museum, has this month issued the six hundredth number of the *Geological Magazine.* We have still with us three other distinguished contributors to the initial number: Sir Archibald Geikie, and Professors Boyd Dawkins and Edward Hull. The two latter have won fame in economic geology, Boyd Dawkins at the Kent coalfield, and Hull as an authority on British coal resources.

THREE distinguished inventors have been removed by death during the past month. Herman Frasch was prolific of new ideas; those most likely to be remembered were connected with the elimination of sulphur compounds from petroleum and with the mining of deep-seated deposits of native sulphur. Paul Heroult founded an enormous industry in Europe based on hydro-electric metallurgy, and developed the electric process for producing aluminium. Joseph Wilson Swan will be remembered in connection with the incandescent electric light, and, in the realms of photography, as the introducer of carbon prints and rapid plates.

PRECAUTIONS are usually taken to prevent the depredations of the gold-stealer by covering amalgamating plates or placing them in a separate building, and by locking zinc-boxes and precipitation-presses. But little or nothing is done to protect the gold solution during its travel through vats, tanks, and launders. The necessity for further steps to check the machinations of the astute thief is exemplified by the case of one of the large Kalgoorlie mines where the solution has been robbed systematically by means of filter-cloth bags containing zinc shaving carefully suspended below the surface in the gold-tanks. Three of these bags were found, and their condition pointed to the plan having been in operation for some time and their contents having been extracted in regular sequence. When the bags were taken to the clean-up department it was found that they contained bullion to the value of £300. We quote this incident so that it may provide a hint for our metallurgical friends in all parts of the world, and we invite correspondence on the subject recording similar instances of experience and giving suggestions for ensuring the safety of the gold during its passage through the plant.

THE claim that fuel-oil and petrol can be produced from coal is to be tested on a large scale by a company called the British Isles Oil Producers, shares in which have been underwritten to the extent of £500,000. The company acquires a cannel-coal deposit at Ballycastle in Ulster, and will erect a carbonizing plant on the Del Monte system. There are at the present time many plants used in the carbonization or distillation of coal, namely at coke-ovens, gas-works, and chemical works. These produce benzol and other volatile hydrocarbons similar to petrol, and the heavier compounds are refined for the production of phenol, naphthalene, anthracene, and a multitude of other organic compounds used in dyeing, explosive manufacture, disinfecting, tarring the roads, etc. The Del Monte process is intended to produce the heavy oil in a form suitable for use in steam boilers or in internal-combustion engines. It remains to be seen whether this method of dealing with heavy hydrocarbons is preferable commercially.

THE CONFUSION between the various kinds of ton is well exemplified in the report of the Leeuwpoort Tin Mining Company, where the ore raised is given in short tons and the yield of concentrate in long tons. To a mining engineer the short ton of 2000 pounds affords many advantages in calculation, but in the commercial world where ore or concentrate is bought and metals are sold the long ton still holds its own. In gold mining the short ton is universally used, and the managers have no difficulty with their product because the unit is the ounce and not the ton. The simplification of our cumbrous system of weights and measures will never be effected in mining and metallurgy as long as the smelter controls the situation and the metal merchant conforms to his system. It is commonly supposed that the hundredweight was fixed at 112 pounds and the ton at 2240 pounds in the old days of "good measure, pressed down, shaken together, and running over." But the probability is that the long weight is a legacy of the bad old days when millers took their multures twice so as to make sure they had not forgotton, and when the poor peasant and miner had to deliver the goods on the same principle, so that the landowner, abbot, or overlord should be on the safe side in the bargain.

AS A RULE provision is not made for a reserve of ore at surface, and all that is hoisted is sent direct to the treatment plant. Copper mines provide an exception, for the reason that it is desirable to have a large store of ore in order that the smelter-charge may have a regular sulphur and slag-forming content. Such a reserve is seldom accumulated for the purpose of protecting the stamp-mills and the concentrators against an unexpected stoppage in hoisting. Two months ago we commended the Broken Hill mines for accumulating supplies of ore between the shafts and concentration plants. It is also due to the manager of the Hutti gold mine in Hyderabad, India, to mention that he provided a sufficient supply of ore to keep the mill going for two months while the head-frame of the shaft was rebuilt and part of the timbering renewed. No doubt many of our readers have displayed similar foresight, but the incident is sufficiently uncommon to deserve mention when it happens.

WE do not deem it desirable to say much concerning the crisis precipitated by Mr. Arthur M. Grenfell's speculations, until such time as the matter has been further investigated. More than once in the past we have animadverted against his notions of company finance and his ideas of the responsibilities devolving upon the director of a joint-stock company. Comparatively recently we condemned his discourteous disregard, as chairman, of a protest made in good faith by a Santa Gertrudis shareholder. Such incidents may seem trivial, but often they indicate the mental attitude of individual promoters and financiers toward minor shareholders, and toward the public, on which they depend for support. Fortunately, the effect of his reckless operations has been restricted to financial institutions able to meet the strain; the public escapes immediate injury, largely owing to the timely assistance of a group of mining operators in the City, and, it must be added, the sagacity of one or two directors on the boards of the companies involved. Mr. Grenfell was a director of the Camp Bird, Messina Development, and Santa Gertrudis mining companies, besides numerous Canadian enterprises; he or his directors were sole directors of the syndicate formed to re-organize the Natomas Consolidated and Union Oil companies. He was practically the Canadian Agency, which served as a medium for his financial operations. Finally, he was a director, until February 17, of Chaplin, Milne, Grenfell & Co., merchant bankers of high repute, brought to the ground in consequence of his speculations, which impaired the credit of the firm to such an extent as to place a sudden strain on resources otherwise ample.

New York.

However often the European traveller may enter the chief port of the New World, he cannot be insensitive to the first sight of the wonderful city on Manhattan island. The incoming steamer cautiously follows the tortuous channel past Sandy Hook and enters the outer harbour, protected by the pleasant shores of Staten and Long islands, still draped in the mists of morning. The sight is welcome to the seafarer. But what is that over the port bow? Above the low-lying mist rise the pinnacles and towers of a dream city, baseless as a vision and piercing the clear blue sky of elfland. No frequency of arrival at New York can stale the beauty of this apparition. Soaring from a flat island and above a mild landscape, the many-storied structures are massed so as to present a splendid silhouette, cleft by the lines of streets, which penetrate this vast hive of industry like deep canyons. A nearer view of the tall buildings does not diminish admiration. Most of them have architectural beauty; owing to their height, however big their base, they assume the shape of towers; the mere continuity of the vertical line is a persistent surprise. The tallest, the Woolworth building, is 790 feet high, with 54 stories and the capacity of a town. Viewed from afar it appears like the fabric of a vision; seen from the street it is a precipice carved by centuries of toil. The interior of such structures is in keeping with their exterior. Such business centres as the City Investment, American Express, Trinity, and Woolworth buildings have been finished with all the loving care bestowed upon a cathedral. Indeed, it is here that the New Yorker worships the gods of his idolatry—the ticker and the tape. They are the cathedrals of commerce, and symbolize the authority of the dollar. There is more than pathos in the sight of Trinity church, the spire of which was once a landmark, but is now dominated by many-storied traceries of steel and stone. The old graveyard and the little steeple are lost amid the proud giants of a later day. Trinity church faces the Wall Street canyon, where congregate the dynamic minds of the greatest group of industrial adventurers in the modern world. And if the visitor goes 'up town,' to the region of shops and department stores, he will see evidence of the same relentless energy. Such shops as the Altman and Tiffany have artistic merit, as well as size. Even the railway stations, notably the Pennsylvania and New York Central depots, are built on a colossal scale and with a splendour of design that must please everybody except the shareholders in those two railway companies. Finally, we come to the private houses, many of which also bespeak the assurance of great wealth in a country where the income tax has not, as yet, checked exuberance of display. New York is the expression of superb arrogance; it is the last word of modern materialism. Unrest pervades its spacious avenues. The tall towers pierce a smokeless sky, but at their feet a riot of noise rules day and night; the strident voices of people in a hurry strive against the rattle of traffic; the tram-cars, elevated railways, and electric subways are a veritable nightmare of sweating crowds hustled like parcels through a pneumatic tube. Even the lofty magnificence of the financial district is spoiled measurably by continuous re-building, for a structure is soon deemed out of date and is pulled down to make way for something better, bigger, or higher. Unceasing disquiet is the keynote of a bewildering medley of races inhabiting what lately seemed our dream city. New York is an ethnologic melting pot. All kinds of languages are heard and papers in strange tongues are read. Greeks from Aleppo and Alexandria, Jews from Damascus, Levantines, Croatians, Negroes, Creoles, all sorts of pagans hustle the timid visitor. These cannot be called 'foreigners,' for that word we keep for our polite friends nearer home; they are Huns. Thus our fairyland vanishes as we penetrate its portals. But, as is often the case in the New World, we must not stop at the first impression. Alongside the piratic finance and gross materialism of Lower Broadway we may contrast the ethical ideals and the beneficent endeavours of Morningside, where a great university is the exponent of the higher phases of that complex mode of living we term civilization. Museums, picture galleries, hospitals, schools and colleges, devoted not only to present needs but to future advancement, indicate that uplifting forces are at work with a compensating intensity, and in a manner adapted to the requirements. For the professors, teachers, and expositors of the higher learning are active members of the larger body politic, while the president of the university is a statesman as well as a scholar. The vastness of the human spirit encompasses them all; the invincible youthfulness of the dawn possesses them. They are "ancients of the earth and in the morning of the times." The crass materialism of those towers of Babel is interwoven with threads of gold that will endure while the coarser fabric falls to decay. When, therefore, at eventide, the outgoing steamer swings from the wharf and we bid farewell to the great buildings silhouetted against a twilight sky, we see them illumined in a glory of light, which, as much as the steam or the steel, is the product of industrial progress.

Columbia School of Mines.

The recent celebration of the semi-centenary of the School of Mines of Columbia University evokes an expression of good-will not only from the former students of that famous institution but from the larger number to whom technical education is a matter of immediate interest. For us, and for many others, the academic aspect of the subject is warmed by personal acquaintance with the Columbia graduates honourably prominent in the world-wide field of mining engineering. We join with them in acclaiming a wise and kindly Alma Mater. Indeed, the recent convocation at New York was remarkable for the keen affection expressed by the assembled graduates toward their teachers, the living and the dead—dead, yet living in the hearts and lives of their former pupils. While viewing the brilliant audience that cheered the surviving Van Amringe and Chandler, that received with enthusiasm the eulogies of the departed

Egleston, Vinton, Newberry, Trowbridge, and Barnard, that gave the greeting of a comrade to Butler, Kemp, Walker, and Munroe, it was made clear that the human tie counted for much in the effectiveness of the years of instruction. The maintenance of lovable traditions is an imperishable bond between the sons of Columbia. She has produced not only technical specialists, but men—men built on a scale of twelve inches to the foot. They are the product not of a system of teaching only, but of teachers having commanding and sympathetic character. We were surprised to hear Dr. Chandler, one of the founders, still splendidly vigorous, lay stress on the fact that in the starting of the School it was distinctly laid down that the 'humanities' should be omitted from the curriculum. They were; but the omission has not prevented the Columbia Mines men from being intensely humane, from exhibiting the qualities most useful in the present dispensation, from facing life in all its complexities with the courage and sanity that are the best gifts of a liberal education.

The school founded by Thomas Egleston in 1864 has fulfilled its destiny. In the future the ascendancy of its graduates may become less evident, simply because so many new schools have been started, but for 50 years the men of the Columbia School of Mines have played a notable part in mining, especially in America. They have proved themselves to be the product of conditions favourable to an efficient training. It may profit others, therefore, to ascertain the nature of those favourable conditions, so that, if possible, they may reproduce some of them. It is related that when Sir William Harcourt heard that there was some talk of selecting W. E. Forster as a successor to Gladstone in the leadership of the Liberal party, he exclaimed: "What! are we to be led by a man who couldn't construe a chorus of the Agamemnon?" That is one point of view, and it is one for which we do not lack sympathy. On the other hand, Egleston and Chandler refused to consider that man educated who did not know the composition of the water he drank or the air he breathed. Not to be able to construe a Greek verb seemed to them a smaller blemish than to be ignorant of the first facts of existence. The Columbia school was started in the dawn of the new learning, at a time when Darwin and Huxley were sounding a bugle-call to scientific observation, and to the scientific imagination that was to be the indwelling spirit of an industrial civilization destined to change the face of the earth and the whole aspect of human life. It may have had it defects—and they are nowhere more apparent than in the City of New York—but it had one unquestionable result: to place Science in the forefront of human knowledge and to stimulate the application of organized common-sense to all the multifarious works of man, in shop and foundry, mine and mill. Thus the Columbia student in his class-room breathed an invigorating air. He found it also at home. The earlier students came from New York and Brooklyn, and later from the neighbouring New England states; they were the sons of a race that had conquered the wilderness, of men that were the pioneers of industry on the American continent; they inherited energy and initiative; they came from commercial surroundings, and knew the value of money; they were dwellers in a city vibrating with eager vitality and aggressive materialism. No wonder that the Columbia student was mentally alert, cheerfully adventurous, and keenly appreciative of the basic purpose of mining, which is, to make money by exploiting mineral deposits. On top of that he had good teachers, especially in mathematics. Indeed, we are inclined to impute much of the success of our Columbia friends to the mental training inherent in a thorough drilling in mathematics as taught by Professor Van Amringe. No discipline can be more useful to a growing mind. Good teachers of mathematics are rare, and to 'Van Am'—as he is affectionately known in distant corners of the earth—the Columbia men owe a great debt. Thus we find that by heredity, by environment, by teaching, these men were highly favoured for preparedness to perform the work of mining engineering. They had a further aid: from the threshold of their careers they lived in an atmosphere stimulating to the professional spirit. With no Army and Navy, and Reserve Forces, socially above them; with no Church or landed aristocracy to claim precedence; with no ancient sediments of society to smother their volcanic energies, they could feel that if they did their work honestly and well they were the peers of all other good men and true. They enjoyed equality of opportunity, the supreme gift of a democracy. That stimulus, joined with other favourable factors, has made them what they are: captains of industry. We join with them in acclaiming the school that prepared them so well for the work of life and we hope that henceforth, as in the past, she may be "the mother of men."

The Technical Committee.

A new departure appears to have been made in the case of the Burma Corporation. Instead of employing a consulting engineer to guide the mining and metallurgical operations, the board of directors has co-opted a committee of three technical experts, giving them seats on the board, so that they become a sub-committee of the central administration. Something of the kind was foreshadowed by the reference to three engineers, instead of the usual solitary advisor, in the case of the Russo-Asiatic Corporation. Apparently men of diverse experience and attainments are to be retained, so that the varied mining and metallurgical problems are to be submitted to individuals having special aptitude for solving them in terms of eventual dividends, while, at the same time, this committee of experts includes at least one man of such calibre as to be able to envisage the whole scheme of operations. This departure from established custom is bound to prove highly interesting to the profession and to those dependent upon the profession for guidance in the complexities of the mining industry. Frankly, we deem it advantageous to all concerned. The multitudinous phases of modern mining and metallurgy cannot all be within the compass of any one engineer's equipment, whether young or old, and special knowledge concerning one of them is usually obtained at the expense of the others. Even the youngest of us is not infallible. Those who know most are best aware of their deficiencies. Co-operation is the mark of a higher civilization. Generalities apart, those engaged in mining are made often unpleasantly aware of the importance of the personal equation; hence they will appreciate the usefulness of a new factor likely to correct the aberrancies of the individual. Every engineer, like ordinary mortals, has his times of maximum and minimum efficiency, as modified by temperament, physical health, or mental vigour. It happens occasionally that a critical decision, a choice of methods or a line of policy, has to be made at a moment when a sluggish liver or a domestic disturbance renders it difficult to intent the whole force of a normally capable mind upon a given subject. To decide is imperative. At such a juncture it is not only comforting to discuss the matter with two capable colleagues: it is an obvious safeguard against error. This is true of most human affairs. For example, the general administration of a company is commonly in the hands of a chairman or some other dominant member of the directorate, presumably checked by consultation with his associates on the board. The consulting engineer, to whom matters of chief importance are submitted, stands alone; for technical problems of any intricacy are generally beyond the capabilities of a board, which, moreover, usually desires to escape all responsibility in such matters. Apart from the personal idiosyncrasies that we try to ignore in business, the fact remains that the special branches of technology are now so numerous and the application of them in actual mining operations arises so suddenly that it is an enormous advantage to fall back on the resources of more than one man however gifted. In any series of technical operations there are single points that are apt to be overlooked, to the subsequent chagrin of directors and shareholders alike. It is better to be sure than sorry. The breaking of ore and the extraction of metal constitute a small part of the processes involved. These must include provision for supplies of water and labour, the peaceful control of workmen, the establishment of pleasant relations with the local government, the vagaries of metal markets, the financial considerations with which mining begins and ends, with their ultimate bearing upon working capital, equipment, and dividends. Of course, these are matters vaguely recognized at the inception of any mining enterprise, but one or other of them usually escapes proper attention owing to the fact that they are not of equal interest to a new board of directors, while the consulting engineer cannot be in two places at once, on the mine and in the London office. Moreover, the solitary engineer faces a board of five, seven, or nine directors, and must be a man of unusual force not to feel the odds against him in matters concerning which there is disagreement, especially when one of the directors, as is frequently the case, controls the position, supported by assenting dummies. In such a case the technical committee carries greater weight, with less insistence, and is consulted by the board in a spirit of larger deference. In short, the technical committee becomes a powerful sub-committee of the administration. Under these conditions, we suggest, the Great Cobar fiasco, for example, would have been much less likely, if not impossible. The financial blunders, the technical errors, and the break-down in management, were due in large part to asking engineers to estimate the capacity of a mine without regard to the working capital to be provided, expecting a copper metallurgist to act as the chief executive of a big business, and throwing a multiplicity of problems at the head of a single engineer. After all, the cost of technical advice represents a cheap form of insurance. It is the one item of expense that is treated with most uneconomic niggardliness. In any important undertaking the difference between the retainers paid to three, as against one, is negligible, if the desired result be achieved. Moreover, each one of the three can afford to accept appointment for a smaller fee than he would ask if employed alone; the responsibility is shared; the risk of error is diminished; the anxiety is lessened to no inconsiderable degree. The engineer in demand for such honourable engagements can serve on more than one of these committees and enjoy greater freedom than if he were the sole advisor of one big enterprise. Speaking broadly, we believe that this departure tends to enhance the usefulness and the dignity of the profession. It will make a desirable inroad upon large and unwieldy boards of directors, by eliminating the mere dummies and stool-pigeons, giving their places at the council-table to the engineers, while at the same time affording the forceful and hard-working director the sort of colleagues he needs most. We assume that not only will the members of the sub-committee be directors, but that their share-holding will be limited to the legal qualification, to be furnished for them in compliance with the law, but without any idea of participation in speculation. We hope, also, that each member of the technical committee will be prepared, and will be asked, to give his word not to deal in the shares of the company with which he is professionally connected. For those who look upon mines as a means of financial leger-demain and for those who regard them as counters in a gamble controlled from the board-room, these ideas will prove most objectionable, but to the real captain of industry, as distinguished from the *chevalier d'industrie*, the innovation will have obvious merit.

Flotation Litigation.

As we briefly mentioned last month, the United States Appeal Court has provided another instance of the vagaries and uncertainties of patent litigation. While the flotation quarrel in England and Australia has been concerned with the prior claims of the Elmore patents over those of Sulman, Picard, and Ballot, belonging to the Minerals Separation company, in America the owners of the latter patents have been the attacking party, bringing action against Mr. James M. Hyde and the Butte & Superior Mining Company for infringement. At the first hearing, in the Montana court, the defence alleged that the plaintiffs' process had been anticipated, quoting the Everson, Froment, and other patents as instances. The arguments before the court were kept within narrow compass, and the judge founded his opinion on the detailed differences between the Froment and the Minerals Separation or 'agitation-froth' processes. When Mr. Hyde and his friends took the case to the Appeal Court, they widened the argument by relying also on the Schwarz and Kirby patents, and presenting the matter on broader lines. The result has been, as already mentioned, the reversal of the opinion of the lower court, and the declaration of the invalidity of the Minerals Separation patents on the ground of want of novelty. Before discussing the judgment in detail, we may say here that Minerals Separation will not sit content with this judgment, and, if any means can be devised, will carry the question to the Supreme Court of the United States. We say "if any means can be devised," because of late years the Supreme Court has declined to hear patent appeals unless some special plea based on the interpretation of the law should be placed before the court, or unless some additional evidence of unusual importance should be presented. We have not sufficient space at our disposal for a full report of the judgment, and we therefore refer such of our readers as are interested in the details to the issue for May 9 of our contemporary, the *Mining and Scientific Press*. It is sufficient for our purpose to state that the judges considered the Minerals Separation process to be anticipated by the Everson, Kirby, Froment, and other patents on the several scores of the use of oil, acid, and stirring. They were of opinion that the amount of oil used had no bearing on the question; they did not differentiate between ordinary stirring and rapid agitation; and they held that the selective action of oil in agglomerating sulphide particles was the same whether the object of its application was to float or sink the aggregates thus formed. Furthermore, they interpreted the utility argument in a different way from the court below, by ruling that utility could only be introduced when it helped to interpret otherwise doubtful cases, holding that the commercial success of any invention depended on many other things than novelty and ingenuity of idea.

To enter into a debate as to the reasonableness or otherwise of this and other legal judgments would be futile on our part. It is more to the point to urge our view that patents and courts of law appear unable to protect engineers and metallurgists who have devoted their intellectual energies and their financial resources to developing processes, and that the time has come for the mining and metallurgical profession to take these patent disputes out of the hands of the lawyers, and constitute a chamber of arbitration, or to petition the Government to allow technical advisors to sit on the bench alongside the judges. Many disputes in civil engineering circles are settled by arbitrators. The railways and canals have a special court, and, in the Admiralty division, representatives of Trinity House assist the judges. It stands to reason that at present the reward of a life's exertion is in the hands of two sets of lawyers, one on the bench and the other appearing as counsel, neither having any direct knowledge of the matter in hand or of the personal factors in the case. The arguments used are not always based on equity, but introduced merely with the object of appealing to the untechnical mind on the bench. We believe that a court of arbitration, official or otherwise, could have settled the dispute between Minerals Separation and Elmores on a satisfactory basis, giving both parties the benefits that they undoubtedly deserve, and could have arranged terms between Minerals Separation and the copper producers of America that would have given the patent-owners due recompense and at the same time removed the antagonism to the payment of royalty on the part of the mine-owners. Our views may be considered Utopian and based too much on the existence of an ideal frame of mind. It is not, however, so much this feeling that impresses us as one of regret and even of disgust that large sums of money intended for developing the metallic resources of the earth should be frittered away among the lawyers and be lost to their beneficent object.

Te Aroha.

We have received the report of the Geological Survey of New Zealand on the Aroha Subdivision. This deals with an important mining region in the North island and is the work of Mr. J. Henderson, assisted by Mr. J. A. Bartrum. The report is interesting to mining engineers, because it concerns such well known veins as those of the Talisman Consolidated and Crown Mines, and also because it deals with the economic geology of lode-fissures traversing Tertiary eruptives ranging in age from the Miocene to as late as the Pleistocene. A remarkable feature of this mining area is the Waiorongomai Buck Reef, a zone of crushed and silicified rock, varying in width from 30 to 140 feet, and crossing the surface in places as a great wall, as much as 200 feet high. The strike of it is nearly due north. While carrying traces of the precious metals, it is profitable only where enriched by one or other of the northeast system of veins, which join it, but generally lose their identity in so doing. It is the cross-veins that contain the principal ore-shoots. These carry both gold and silver, often in the proportion of the natural alloy, electrum. The principal gangue is quartz, usually pseudomorphic after calcite, which becomes plentiful below the limits of oxidation. The principal sulphide is pyrite, but marcasite, chalcopyrite, galena, and sphalerite are noted occasionally. The prevailing country rock is andesite, with breccias and tuffs of the same type. Intense decomposition, or 'propylitization,' characterizes the wall-rocks of the lodes and suggests the action of heated emanations coincident with the waning phase of vulcanism. The most intense alteration is evident near the fissures, which are regarded as the vents along which aqueous vapours ascended. Thus the theory of origin begins with faults and sheer-zones; these became channels for the passage of thermal solutions, which attacked the enclosing rock and introduced pyrite, together with the precious metals. Then descending solutions dissolved and re-concentrated the ore-forming minerals disseminated in the rock adjacent to the fissures, and deposited them in the fissures so as to constitute orebodies. Briefly, primary ore-deposition is imputed to magmatic waters and vapours, while the secondary deposition is assigned to meteoric waters, that is, those originating from rainfall. In so far as the explanation concerns the first stage of the process of ore deposition, it presents conditions analogous to those observed in Nevada, in

Colorado, and at Waihi, which is not far from Te Aroha. But the secondary enrichment in this case is credited to descending, instead of ascending solutions, and thus differs from the theory proffered by Messrs. J. Mackintosh Bell and Colin Fraser in their bulletin describing the geology of the Waihi district, where the calcite originally precipitated in the fissures is supposed to have been shattered by later movements so as to permit the up-welling of solutions containing the ore-forming minerals. For rejecting this explanation and preferring the agency of descending waters, the authors of the Te Aroha bulletin adduce the fact that the distribution of ore is plainly modified by the existing topography of the district. The ore-bearing veins traverse obliquely a silicified zone, which is furrowed by a number of gullies and creeks, producing a series of steep slopes. The veins contain orebodies where they cross these slopes. The downward limit of ore corresponds to these surface contours. In general, the veins become fewer and smaller in depth. The mine-waters are laden with sulphates and carbonates, believed to be of meteoric origin. The propylitized rocks are proved, by analysis, to contain gold and silver. It is suggested that the pyrite, so plentiful in the fissure-walls, was the precipitant for the precious metals, when dissolved out of the overlying mass of rock, and carried by geologically superficial drainage into the lode-channels, there to be concentrated into orebodies. From this reasoning, the authors proceed to make an important practical inference: they argue therefrom that the veins will be poor beyond certain topographical limits, specified by name, and that the Talisman bonanza will become impoverished with relative abruptness, as indicated by the high proportion of zinc in the lower workings. Some of these conclusions will prove most unpalatable to the owners of mining property in the district, and may prompt a geological protest. Assuredly twenty years ago any report so frank would have endangered the official life of the director of a Geological Survey, and might have led to the suppression of scientific opinions so outspoken. For ourselves, we believe that Messrs. Henderson and Bartrum have given their testimony with all the sincerity of true science, which knows no make-believe, and that the information they furnish in this report will prove of immediate value to those engaged in the exploitation of the district.

Complex Zinc Ores.

With the spread of metallurgical knowledge, the operations in connection with the reduction of copper and lead ores have been extensively transferred to the mines, and the custom smelter has been left in the lurch. With these two metals the process and practice of smelting may be readily varied to suit the particular supply of ore. On the other hand, with tin and zinc it is better policy to vary the ore-charge to meet the requirements of the process, and thus a custom smelter is in the favoured position to obtain the best results. The two classes of metallurgical reduction, exemplified by lead and copper on the one hand, and tin and zinc on the other, present different problems. Lead and copper ores can be concentrated by fire, whereas the tin and zinc furnaces require the preliminary mechanical elimination of the gangue and other minerals, for the reason that tin oxide has a strong affinity for silica and iron, and that many gangue minerals act as fluxes on the zinc-retorts. Zinc metallurgy has another point of difference that has to be considered in this connection: the temperature of dissociation of the oxide is higher than the boiling point of the metal. Thus the metal comes away as a gas, and its condensation into a liquid is one of the features of the process that requires particular skill. It is easier for the representative of the mine to attack the copper and lead problems than those connected with tin and zinc. Nevertheless, independent metallurgical chemists are continually seeking for alternative processes for the beneficiation of zinc ores, particularly where such ores contain large proportions of other metals. Some of the processes evolved are based on the application of electric heat as a substitute for the gas-generated heat that has, according to the present methods, to be forced through the non-conducting wall of the retort. The large consumption of current and the high renewal charges on the anodes form a serious obstacle in electrothermic processes, and the fact that, owing to the presence of other gases and to great variations in temperature, the loss of zinc is high, while much of it is only recovered as blue powder, constitutes a difficulty still to be overcome. In the meantime, the smelters on the Continent are rapidly improving the scope and efficiency of the gas-fired retort-furnace, and are prepared to buy zinc concentrate with percentages of lead content not contemplated a few years ago. It probably came as a surprise to many to know that the Burma Corporation can sell ore averaging 34% zinc, 24% lead, and 24 oz. silver per ton to the Continental buyers. As a matter of fact, the Corporation's contracts show the price quoted for such ore to be about £4. 15s. per ton delivered, though the present weakness of the zinc market will undoubtedly cause some reduction in the final settlements. According to these contracts, the smelter pays for 75% of the zinc content, for 60% of the lead less eights units, and for 60% of the silver less five ounces; and £3 is deducted as returning charge. The material is not treated by itself, for it is the custom to mix roasted sulphide with calcined calamine or with other zinciferous material. Of course, the price received represents only a third of the nominal value of the metal content, but it must be remembered that two smelting operations are required; after the zinc has been distilled, the residue, weighing approximately as much as the original ore, has to be smelted for lead and silver. Naturally, a cheap mechanical separation of the galena and blende such as is now provided by selective flotation would be vastly preferable to this step-smelting. Such a separation of the metals would be more profitable to both the producer and the smelter. A point that may be urged against this system of smelting is that the zinc-retorts are burdened with material which is not reduced, but which causes an increased injury to the retorts. Experience, however, shows that the lead material, being heavy, does not occupy much of the valuable space, or reduce the zinc capacity of the retort to any important extent. The method will in any case become obsolete before long, when complex sulphide ores will be separated into their constituent minerals by means of selective flotation, and with it will go the electric furnace for treating them.

Origin of Diamonds.

That veteran of diamond-mining, Mr. Gardner F. Williams, treated the members of the Canadian Mining Institute at their meeting in March to a discourse on the subject of which he is a past master. In the course of his address he touched on the origin of the stone, and abandoned his well known disinclination to formulate a theory. It will be remembered that in earlier years he said it was easier to drive a coach-and-four through any theory yet propounded than to evolve one. In his Canadian address he gave his own opinion, namely, that the blue ground was introduced into the pipes from below by aqueous rather than igneous action, in a manner characteristic of the mud volcano. He adduces in favour of this view the fact that the pipes have all been filled exactly to the level of the surface of the surrounding country, which would hardly be the case if the material rose at the high pressure associated with igneous action. Had there been any flow of kimberlite over the edges of the craters and it had been removed subsequently by erosion, the diamonds would have remained and would have accumulated in some favourable situation. At Kimberley, however, no trace of such diamonds has been found, and the nearest occurrence of diamond-bearing alluvium is twenty miles away on the Vaal river, where the stones are of an entirely different type from those mined at the De Beers. He stated that the Kimberley mines lie in basins from which no water flows into any stream; such rain or other water as accumulates runs into pans or *vleis*, where, if not caught and used for mining or other purposes, it is lost by evaporation. These physical conditions are quoted by him as fitting the theory that the pipes were volcanic vents up which mud and gases were forced, and that on the escape of the gas the mud would subside. This ebb and flow would account for the presence in the pipes of pieces of shale at depths of 2500 feet evidently broken from the walls only 300 feet from surface. It will be seen that Mr. Williams' special dictum refers to the origin of the kimberlite rather than to that of the diamond, and his main point is that the material contained in the pipes and craters was of a secondary nature, derived from the decomposition of a deep-seated rock, such as eclogite or other member of the peridotite group. He also adduces the fact that the alteration of the enclosing walls is comparatively insignificant, not at all on the scale usually associated with igneous flows, though of course this slightness of alteration is equally favourable to the igneous theory that the flow originated from a peridotitic rock at the time of loss of isostasy during the uplifts of the plateau in Upper Cretaceous times. Though we quote Mr. Williams' views with the deference due to his long connection with diamond-mining, we are free to say that geologists will find plenty of scope for criticism of his theory. It is only necessary here to mention one or two controversial points. In the first place, mineralogists are agreed that kimberlite is an igneous rock and not a product of hydrothermal action. Second, the supposed mud would be just as likely to run over the top of the crater as a flow of igneous rock; it is impossible to allow that no erosion has occurred since the formation of the pipes, for the course of nature cannot be suspended; and though no alluvial diamonds are found in the country round De Beers, the greater richness of the deposit in the upper portions affords evidence of surface enrichment due to erosion. While referring to Mr. Williams' views, it is fitting to recall the excellent work done by Mr. Percy Wagner in connection with the geology and mineralogy of the diamond pipes, as recounted in his book published a few months ago. In discussing the ultimate origin of the diamond, he explodes the old theory attributed variously to Carvill Lewis and Dunn, and he fails to be impressed with the hypothesis that the diamond is derived from deep-seated eclogite that has been explosively disrupted. On the other hand, he brings a great amount of evidence that the diamond is an original constituent of the kimberlite, and was formed by crystallization from the solidifying mass. He quotes Friedlander, who showed that molten olivine will dissolve carbon and that on its subsequent cooling crystals of diamond are formed. The experiments of Von Hasslinger followed on the same lines, using artificial magmas corresponding to kimberlite, and the results not only confirmed those of Friedlander, but extended their application, notably as regards the effect of titanium oxide in producing black crystals similar to bort. Unfortunately, Mr. Wagner has a way of dismissing theories as fanciful, instead of giving the studied criticism that would be acceptable to their authors and to students. Notably he expressed kindly incredulity with regard to Mr. Orville A. Derby's theory, which was discussed by Mr. David Draper in our pages last year. What will happen to Mr. Williams' theory at the hands of Mr. Wagner we can well imagine.

SPECIAL CORRESPONDENCE

JOHANNESBURG.

Amalgamation rumours still make inroads into the lingual leisure of club wayfarers; and between 5.0 and 7.0 pm. when the social side of business is in its most amiable stage many weighty oracular pronouncements are delivered in the fraternizing circles which congregate to discuss the incidents of the day and the hopes of the morrow. Of all the topics introduced those in any way relating to amalgamation are the most popular, because now that strike troubles are in abeyance and politics are quiescent, there is nothing, except it be the prospect of a trip home on full pay, that appeals so much at the present time to the average intelligent and gregarious citizen. The opinion is now frequently expressed that the next step will be one calculated to bring nearer the day of Rand unification, and that it will take the form of the absorption of one or two of the less financially powerful mining houses by a house which can, so it is said, lay its hands on a million at a minute's notice. Under existing apathetic conditions the houses are cut off from certain operations which used to fill their cash reservoirs better than the profits from actual mining itself, that is, mine flotation and share distribution; and small financial groups which do not control the richer mines feel this deprivation more keenly than larger concerns with more remunerative interests. The waiting game has lasted a long time already, and there being no hint that a strong market will arise to relieve the situation within reasonable time, it follows that these weaker groups may, if the opportunity be given them, take the cash and let the credit go. It can be seen, therefore, that the rumour may have a sound basis of truth underlying it. Should such an absorption take place it will pave the way for others, and finally make Rand unification a fairly simple matter to arrange.

The mineral output of the Union for March was valued at £3,210,806 as against £3,652,101 for the same month last year. For this decline of £441,295 the reduced gold output must be held responsible; and this lower level of production will continue until the native labour supply shows a considerable improvement. Comparative figures for the Union giving the chief items of mineral production of the two months under review and the labour employed are as follows:

	March, 1913			March, 1914		
Gold Mines	Mines working	Stamps	Output in fine ounces	Mines working	Stamps	Output in fine ounces
Witwatersrand	57	9465	760,317	52	9180	657,042
Transvaal outside districts	53	544	31,864	37	549	31,498
Cape	—	—	3	—	—	4
Natal	—	—	10	1	5	131
Union of S.Africa	90	10,009	792,194	90	9734	688,675

Coal mines	Collieries producing	Tons sold	Value per ton at pit's mouth	Collieries producing	Tons sold	Value per ton at pit's mouth
Transvaal	30	413.555	4s. 4d.	28	426.963	4s. 5d.
Cape	9	5,334	11s. 4d.	10	4.876	11s. 8d.
O.F.S.	5	47.202	5s. 6d.	5	54.791	5s. 8d.
Natal	23	247.690	5s. 11d.	20	238.513	6s. 7d.
Union of S.Africa	67	713,781	5s. 1d.	63	725.143	5s. 3d.
Value of coal output		£178,703			£190,573	

	Tons	Tons
Copper, output of concentrate	1699	2658
Tin, ,, ,,	271	396

Labour (all mines)	White	Coloured	White	Coloured
Transvaal	27,218	258.992	23.860	208.025
Other provinces	4,941	43,345	5.198	45,987
Union of S. Africa	32,159	302,337	29,058	254,012

Statistics of diamond production are not available, as they are only published half-yearly. The increase in coal production and the better prices ruling are promising indications that the valuable coal resources of the Union will have the attention paid to them which they undoubtedly deserve. Copper and tin are making fair progress, but one or two tin mines are already feeling severely the drop in the price of the metal. The ratio of white to coloured in the mines of the Union is 1 to 8·7, as compared with 1 to 9·4 in March of last year. The present uneconomical proportion is explained by the philanthropic attitude of Rand employers toward their white employees; they have shown a great disinclination to cause any hardship to white workers, although in the face of the shortage of coloured labour it has been found exceedingly difficult to find any employment whatever for numbers of them, and employment has been provided purely out of kindness and at much inconvenience. A distinctly encouraging feature is that the average working cost for March of this year, 17s. 3d. per ton crushed, is lower than at any time during the past two years. The working costs of a few representative mines will show how general is this improvement:

Mine	Working cost per ton. March, 1913.	March, 1914.
Bantjes	21s. 11d.	20s. 7d.
Crown Mines	16s. 9d.	15s. 3d.
Geldenhuis Deep	24s. 4d.	23s. 3d.
Meyer and Charlton	18s. 0d.	16s. 2d.
New Kleinfontein	18s. 5d.	17s. 3d.
New Modderfontein	19s. 9d.	15s. 7d.
Nourse Mines	21s. 4d.	20s. 4d.
Village Deep	18s. 10d.	17s. 2d.
West Rand Consolidated	23s. 10d.	20s. 11d.
Witwatersrand	14s. 11d.	13s. 3d.
Witwatersrand Deep	19s. 5d,	15s. 9d.
Wolhuter	18s. 2d.	16s. 6d.

From the point of view of cheaper working, therefore, the outlook is undoubtedly most encouraging; and, in general, it may be predicted that the improving tendency shown will be maintained, to the great benefit of the gold industry and through it to other industries.

The New Kleinfontein, all things considered, came well through all its troubles of the past year.

	Year ended December 31, 1912.	Year ended December 31, 1913.
Tons crushed	549,730	540.300
Yield per ton	28s. 3d.	27s. 6d.
Cost ,, ,,	19s. 6d.	18s. 11d.
Profit ,, ,,	8s. 9d.	8s. 7d.
Working Profit	£240,653	£231,524
Bank loan	£174,000	£75,000
Dividend	12½%	7½%
Appropriation balance	£25,540	£46,629
Milling value of ore exposed during year	7·33 dwt.	7·39 dwt.
Reserve tonnage	1,190,663	1,345,216
Milling value	7·59 dwt.	7·53 dwt.

On account of the strikes seriously hampering operations during the period May to July and practically causing the loss of seven weeks' work as far as profit-earning was concerned, the good results anticipated were not secured and the June interim dividend had to be passed. As against this, the decrease in the bank loan and the increase in the balance carried forward are comforting features. The profit per ton and the content of the ore reserve show slight decreases, but the grade of the ore developed during the year was better. There are still 171 reef-bearing claims unworked, and the life of the mine is officially stated to be 12 years from the beginning of 1914. This company was a last-ditcher in metallurgy, inasmuch as it for a long time denied the advantages claimed for tube-mills; and it was also a die-hard as regards adopting the accepted modern custom of giving ore reserve on a mining not a milling basis. This year the report in addition to giving the ore-reserve figures on a milling basis, as above, also gives it on a mining basis, namely, 1,658,481 tons averaging 6·30 dwt., and in future the mining basis will be adopted solely. The mining, or stoping, basis for the presentation of ore-reserve figures is now in general use throughout the Rand; and, on the whole, it is the best way in which to make this important information public. The merging of the Kleinfontein with the Apex and Benoni was confirmed by the shareholders of the respective companies some months ago. It was a case of Hobson's choice with Benoni, and a similar latitude of decision was available in the case of the Apex. As far as working or not working the two latter sections is concerned, nothing can be done until the necessary funds are forthcoming, which will not be until such time as a fresh share issue is likely to meet with success.

The City Deep is a mine that is always interesting to watch because of its great potentialities.

	Year ended Dec. 31, 1912	Year ended Dec. 31, 1913
Tons crushed	479,630	468,800
Yield per ton	35s. 6d.	37s 6d.
Cost ,, ,,	23s. 9d.	25s. 7d.
Profit ,, ,,	11s. 9d.	12s. 2d.
Working profit	£292,654	£296,552
Dividend	12½%	17½%
Balance of cash and cash assets	£109,001	£145,130
Tonnage of profitable ore developed during year	462.991	603,700
Average value per ton	46s. 6d.	52s. 11d.
Available ore reserve tonnage	1,750.800	1,696,550
Average value per ton	8·8 dwt. (37s.)	10 dwt. (42s.)

With the Knights Deep jogging along quite comfortably on 4·3 dwt. ore, there is obviously a handsome profit to make out of 10 dwt. ore. In common with most other mines the City Deep suffers from labour shortage, but it differs from them in not suffering from poverty of gold contents. Unfortunately like an indifferently trained child it has had to fight against the handicap of a defective upbringing. However, it shows signs of outgrowing the rawness of hobbledehoyhood, and its visiting cards are being treated with greater respect by the punctilious investing public. Judging from the results of recent months, dividend prospects are better than in 1913, and it is just possible that the 20% level may be reached during the current year. A paragraph in the report records what in these days might be considered a retrograde step, that is, the replacement of surface electric haulage by steam locomotives. Apparently electrification is in many ways not all that it is cracked up to be.

The Voorspoed diamond mine went into liquidation some time ago, was bought by De Beers, and was allowed to remain closed-down. Representations were made to the Government to the effect that the cessation of operations inflicted much financial loss on the country in general and on the Kroonstad district in particular, and that the mine should be worked. A board of inquiry was accordingly constituted to go into the whole matter, and their report, just presented, may be summarized as follows: The future life of the mine is based on six million loads of blue ground, and it would require £35,000 to re-equip it. Working costs would vary from 2s. 4d. to 2s. 10d. per load and may be taken at 2s. 6d. The yield is estimated at from 12 to 14 carats per 100 loads, and the value per carat at 17s. Taking the figures of 2s. 6d. for working costs, 14 carats per 100 loads as the yield, 17s. per carat as the price to be obtained for the diamonds, and 6,000.000 loads as the life of the mine, a working loss of £36,000 would be shown, which with £35,000 for new equipment would add up to a total loss of £71,000. The Board considers that at the present time and in the present state of the diamond market the bona fide mining and working expenses of the Voorspoed diamond mine cannot be met by the sale of the precious stones found therein, and that such working would result in substantial loss. This verdict, though disposing of any likelihood of re-starting of operations for a long time to come, is satisfactory in another way, in proving that the Government takes great pains to investigate complaints made regarding the working of mines and is prepared to put its foot down whenever it can be proved that a harmful course of action is being pursued by the owners of mining property. It is well known locally, and deserves to be equally well known overseas, that the Mines Department watches over the interests of the investing public and gives close attention to all representations seriously made by shareholders respecting any mine in which they hold an interest. It is easy to criticize a government adversely, and it is always pleasant to be able conscientiously to criticize favourably. Here, praise is undoubtedly merited.

TUBE-MILLS AT VAN RYN DEEP, DURING COURSE OF ERECTION.

A Tin venture, with the title Good Hope Tin Mines, is being floated at Capetown with a capital of £40,000, to acquire rights over a large area of the farm Hazendal in the Stellenbosch district. History does not record any tin mining successes at the Cape in spite of several attempts to prove that profitable stanniferous alluvium and lodes exist nearby. Much money has been lost in ill-starred concerns during the past decade and residents on the Peninsula are to be congratulated on their courage in not admitting metalliferous defeat. In the Transvaal the chief established producers are laying a fair case before shareholders, with perhaps the exception of Leeuwpoort, a mine with considerable possibilities and, so far, a disappointing record.

	Short tons crushed	Long tons concentrates	Working profit	Capital expenditure
Leeuwpoort (March quarter)	12,057	213	£7,483	£1,944
Rooiberg (March month)	3,499	105	£4,104	£531
Zaaiplaats (March month)	3,786	100	£3,919	£401

In connection with the Rooiberg returns it should be noted that £2529, expended on shaft sinking, exploration, &c., has been included in the month's working expenditure.

SAN FRANCISCO.

Borax Consolidated shareholders, and others concerned with borax, will be interested in the recent developments in California. It will be recalled that Borax Consolidated, Ltd., when formed in 1899, acquired the properties of the Pacific Coast Borax Co., properties in Chile, leases in Turkey, and other sources of raw material around the world. At the same time the Pacific Coast Borax Co. of California was formed by F. M. Smith and his associates. This new company received 364,710 of the deferred ordinary shares of Borax Consolidated in payment for the properties transferred, and, having purchased 135,290 additional shares, now holds 500,000 of the 900,000 shares that have voting control of Borax Consolidated. The Pacific Coast Borax Co. is dominated by F. M. Smith, the picturesque 'borax king,' made famous by the '20-mule team' advertisements. He, with L. H. de Friese, J. Gerstley, and R. C. Baker, are managing directors of the Borax 'trust,' to use the American term for companies that have a monopoly or near monopoly. Borax Consolidated has prospered. The net profits have increased steadily, and for the year that ended September 30 last were nearly £362,000. There is an amazing tangle of deferred and preferred and ordinary shares, but after deducting for income tax, depreciation, sinking fund, general reserve, investment reserve, and other minor items, the following payments were made: debenture interest, £74,164; preferred dividend, £44,000; preferred ordinary dividend, £27,000; deferred ordinary dividend, £135,000; carried forward, £45,397. The rate of payment on the deferred ordinary shares in the last four years has been at $12\frac{1}{2}$, $13\frac{3}{4}$, $13\frac{3}{4}$, and 15%. The shares have a par value of £1 and have naturally sold at a premium. F. M. Smith became involved in real estate speculations at Oakland, California, and in railway and traction ventures that were not altogether profitable. As a result his interests were placed in the hands of trustees some months ago, and various of his properties have already been sold. So far his Borax shares have not changed hands, though there have been negotiations with several parties and various rumours of sale. It is to be noted that their transfer, or even the sale of a part of them, might mean a change in control of Borax Consolidated. Naturally the matter has raised the question of the value of the shares. So far they have been sold mainly on the basis of the dividend record, though there has been some question whether the richer parts of the colemanite deposits were not being exhausted unduly; that is, whether the American mines are not being gouged. There is no fear as to the total amount of borax available, but merely a question whether future costs will not be higher. Another danger to the company is in connection with the Tonopah & Tidewater railroad. This line was built to provide transportation from the mines to the Santa Fe railroad, and in the flush of enthusiasm over southern Nevada, following the discovery of Goldfield, it was extended until now 170 miles of line is operated. Unfortunately the railway does not pay. While the yearly deficit has not been large, there is no great encouragement to believe that it can be permanently decreased. The country traversed is desert, and there seems little possibility of building up a permanent traffic. The main business at present is with the mines of the Borax company, and if for any reason these should be closed, there would be little left. It does not seem to be generally appreciated that the bonds of this road are guaranteed both as to principal and interest by Borax Consolidated, Ltd. There is £500,000 in $4\frac{1}{2}$% bonds issued in 1905, and £175,000 in 5% issued in 1907, out of £250,000 authorized at this time. If for any reason Borax Consolidated should find it necessary to transfer its main activities to another field, there would be here a heavy loss to face.

Competition in borax production has so far been unimportant, though there are independent producers. There is now, however, the threat of competition that may put another face on matters. The American Trona Corporation, backed by the Consolidated Gold Fields of South Africa, has completed a railroad to its works and is building a plant designed to manufacture soda ash, borax, and potassium chloride, from the brine of Searles lake. Interesting details of this enterprise were given in the *Mining and Scientific Press*, June 14, 1913, and since then rapid progress in construction has been made. Soda ash has already been manufactured on a working scale, and before October it is expected that the manufacture of all three of the salts mentioned will be under way. The plant now being built is small, though each piece of machinery is of standard size. It is designed with a view to experimental work directed to obtaining the maximum efficiency in the larger works to follow. The process used was worked out by John W. Hornsey, and after being tested in the laboratory was applied on a larger scale in the old works of the Pacific Coast Borax Co., now under lease to the Trona company. It consists, essentially, of evaporation and fractional precipitation of the soda ash, salt, sodium sulphate, borax, and potassium chloride. The material is derived from brine pumped from the interstices of a crystal body covering several square miles and extending to 60 or 70 ft. in depth. The quantity available is undoubtedly adequate, and the process to be used has been tested sufficiently to assure its success and economy, though an exact statement of costs must wait until operations are on a large scale. The plant will be built in four units, and when all are working is to produce daily 500 tons of soda ash, 490 potassium chloride, 225 borax, 1500 salt, and 590 sulphate of soda. There is no market available for the salt and sulphate, so the Trona Corporation must derive its revenue from the sale of the other salts. The amount of potassium chloride contemplated is less than that at present annually imported into the United States, and would in any event be absorbed by the normal growth of the American market in five years. As the raw material is obtained by pumping as against mining under peculiar and expensive conditions in Germany and costs will be low, little fear is felt as to the market for this material. The amount of soda ash to be produced is equivalent to about 5% of the present world's consumption, and as freight to deep water at San Pedro will be not more than $1·50 per ton, it is felt that a ready market, probably in the Orient, will be found for all that it is now proposed to manufacture. The critical factor is the borax. It is evidently a matter of book-keeping, so far as the Trona Corporation is concerned, as to what the borax costs. It must be extracted from the brine before the potassium chloride can be recovered. It can therefore be sold for anything over freight and handling charges. The amount to be made is about equal to the present world's consumption, and if it be marketed, borax mines must close elsewhere, at least temporarily.

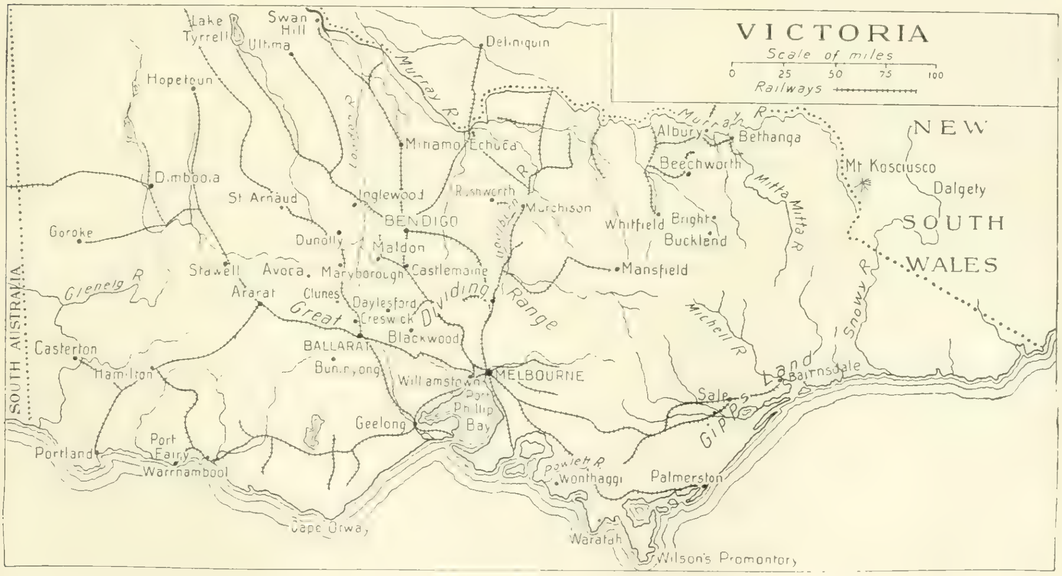
In the Borax Country, California.

Borax Consolidated has succeeded in materially expanding the market for its products. The United States output has increased from 5959 tons in 1895 to about 43,000 tons in 1913. Since 1870 the price has fallen from 35c. to 4c. per lb. Probably a still lower price would increase the use of borax, especially in the dyeing, enamelling, and glass trades, but there is no evidence that the world's markets will absorb double the present output in even a few years, without a material decrease in price. It is one of the curious chances of time that the Trona company is now operating in works originally built at Searles, one of the pioneer plants of the Pacific Coast Borax Co., the prosperity of which is threatened by the new development. The San Bernardino Borax Co., a subsidiary of the Pacific Coast, owns the land and the works. The land covers the mud flats, but does not extend into the crystal body originally located by the California Trona Co. with a view to the manufacture of soda. This company leased the old borax works, and to guard against any possible competition, it was stipulated that during the life of the lease, which has still four years to run, the Borax company should have an option to purchase at 1c. per lb. all borax that might be produced by the Trona company, and the latter should have a reciprocal option at $\frac{1}{5}$ c. per lb. on all soda made by the Borax company. At that time potash was known, but its value was not appreciated. The California Trona Co. borrowed money from the Foreign Mines Development Co., and for various reasons came to grief. The Gold Fields people bought control of the California Trona Co., and eventually organized the American Trona Corporation, to build and operate the works. The value of the potash salts was discovered by one of the engineers of F. S. Pearson, who at one time held an option from the California Trona Co., and the discovery was exploited by the United States Geological Survey. When first the Trona company began work, there was no intention of producing borax, but with the development of the process for making potash salts a new situation arose. Borax Consolidated still holds the option on the borax output of the plant, but cannot take the amount offered without interfering with its regular business. On the other hand, while Borax Consolidated undoubtedly has a firm hold on the market and a newcomer will have to fight to get in, the big customers are those who would buy on specifications and price, and, within rather wide limits, the latter is unimportant to the Trona Corporation. The situation is one of much interest. The Borax company did have one club over the Trona Corporation until recently in that it owned the only suitable patented land for the erection of a plant. Following the announcement of the Geological Survey, all the lands round the lake were withdrawn from entry in 1912. This does not affect the locations on mineral land, including the crystal body, which the Trona company owns and which were made prior to the President's proclamation; but it did prevent acquirement of land for the necessary mill and townsite. After proper showing of the non-mineral character of the land and annoying delay, a sufficient area was recently released and has been purchased by the Trona Corporation. The latter accordingly no longer has to have the Borax property, though it would be convenient to own the land, and interested observers anticipate that in the end some amicable adjustment will be made between the two companies.

MELBOURNE.

Labour.—The labour question in Australia is continually rising to confuse and to exasperate. The latest trouble threatened is at Kalgoorlie, where the Miners' Association has declared that its members shall not work with non-unionists. Whereupon the Chamber of Mines, speaking for the combined mine-owners, replied that if the miners will not work with the non-unionists they would have to walk the town as idle men. This retort cut the knot. News has come that a large meeting of the men decided that they had no wish to cease work just now. Hence the crisis may be regarded as past, though there is no safeguard that the same issue will not be raised a little later on. The truth is that a few busybody officials are stimulating the young miner to take up the non-unionist fetish. A movement in this direction, begun in Victoria among the alluvial miners and the lode miners of Bendigo, failed lamentably, though an attempt was made to murder two non-unionists who had taken refuge in a shaft by throwing logs and pieces of timber down the workings. So the inspiration seems to have come to abandon the older and smaller districts in order to get the unions in big mining centres, like Kalgoorlie and Broken Hill, to ban the non-unionist from employment. The agitation is sure to recur, for the next step may be to get the Federal Arbitration Court to give legal standing to the idea of preference to unionist. This nearly happened at Broken Hill. All that can be said is that, fortunately for those who believe in freedom of contract, Justice Higgins has been given leave to visit the old world. Then, in the far north the miners of the Cloncurry district are asking for 44 hours work per week and a high wage-rate, instead of contract work. The mines there, however, are on the defensive. At the moment it is not clear whether the men intend to insist on the concessions they demand. They know full well that they have only to make their way south to find employment in a better climate and under easy conditions. So the outlook in the north is not exactly to the liking of the man who wants to create a big industry in the copper region of North Queensland.

Flotation. — The decision of the Privy Council in respect to the Elmore claim against the Minerals Separation, Ltd., for infringement of patent rights in connection with the flotation process has been taken as giving to the Minerals Separation and Amalgamated Zinc group a monopoly. According to a good many thinkers, objection should not be taken against a beneficent monopoly, and it ought to be evident to the shrewd group that stands opposed to the Elmore people that if they have a monopoly they must use it wisely. There have been rumours that influence has been exerted already to assure to the controlling company certain contracts for dealing with some of the Broken Hill products. There is no evidence that these rumours rest on a stable foundation. If they do, it must be pointed out that action of the kind in a country like Australia is like playing with fire. Here the Labour party wishes to have State control of monopolies, and the mining interests of the country know well how to use politics on their behalf if any other action on the part of a monopolist is attempted. It must be repeated that there is no ground for believing that the assertions stated above rest on solid foundations, but the rumour is of interest as it indicates how closely the course of events is watched on this side. A suggestion has been published in Adelaide that in view of the statements made by the Elmore people that they are not yet knocked out of the law courts it might be desirable in the interests of the mining industry that the States of the Commonwealth should purchase outright the patents covering the flotation process. This it is mentioned was the action that was taken in connection with the cyanide process. The suggestion is novel and shows how far the ordinary Australian is prepared to call the State to his aid whenever he thinks he may be hard pressed or may have trouble in getting something he wants at the cheapest cost to himself. Of course if the governments agree to co-operate they could easily carry a scheme of the kind, but with the present condition of finances it would take much persuasion to induce them to move.



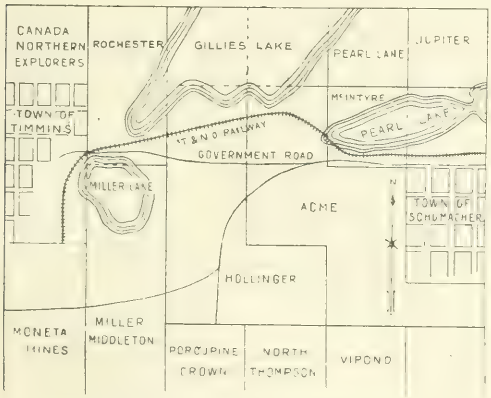
Deep-lead gold mining in Victoria is now entirely in the hands of local investors, with the exception of the Loddon Valley recently re-floated in London. This property has been worked to a small extent, and seems to have some promise. It is understood that the principal backing comes from a representative of one of the largest manufacturers of patent pills in Great Britain. Today the burden of showing that the deep-lead mining is deserving of support rests mainly with the New Langi Logan company which is seeking to develop the Langi Logan gutter. The auriferous lead has been entered and so far the returns are about 1 oz. to the fathom—a fathom being 36 sq. ft. on the bottom of the gutter. In nearly all our big alluvial mines, the cost averages 12 to 16 dwt., according to the nature of the bottom on which the alluvium lies and whether the alluvium is taken out wet or drained. It is computed that if the New Langi Logan pushes on its drifts with the pressure of water as strong as it is in the face, it will cost £2. 10s. per foot to carry the driving forward. Whereas if rises are put up at different points in the gutter and the water drained down in the main under the level from the alluvium, the driving can be done at a cost of 6s. per foot. Those in control of the New Langi Logan have only one course to pursue, that is to suspend trying to put up rises and to pump until the water is under control. The worst feature of our alluvial mining is that claims higher up and lower down the gutters are not made to contribute to the cost of pumping done by their neighbour, although this work may help to drain their mines. Unfortunately, on the Langi Logan lead, the most bare-faced loafing is being done by companies outside the New Langi Logan, but no one in the Mines Department seems to be capable of realizing, without complaint from the mine at work, that this loafing ought not to be tolerated. Either mines should be compelled to put their shafts down and begin pumping, or they ought to make way for people who are prepared to undertake that work. If the New Langi Logan proves successful, mining over 17 miles of the lead system will be commenced.

TORONTO.

Cobalt.—The estimated net value of the shipments of the Nipissing for April was $323,251. The production for the month was of the estimated net value of $225,703. The high-grade mill treated 170 tons, and shipped 550,150 oz. silver. A summary of the year's operations of the La Rose by the general manager, R. B. Watson, gives the production at 2,636,000 oz. or about 180,000 oz. less than the previous year at a total cost of 22·8 c. per oz. The combined surplus of the holding and the operating companies is $1,602,005, or $23,413 higher than a year ago. Ore reserves have decreased about 700,000 oz.

The stock of the Peterson Lake has been placed upon a 7% dividend basis, the first payment of 1¾% being due from June 1. The profits for the year ended April 30 amounted to $167,377. The Crown Reserve has won a protracted lawsuit, which was finally decided in its favour by the Imperial Privy Council. The action was brought by John Black and others who claimed that 569,950 shares of the company's stock were held in trust for them, and the Privy Council confirmed the judgment of the lower courts and dismissed the action. The new directorate of the Temiskaming, after an examination of the mine, reported that from the 400-ft. level down to the lowest workings at 650 ft. there was nothing but low-grade ore in sight, and that the resumption of dividends was out of the question until new discoveries of ore had been made. Since this report, a high-grade vein on the 575-ft. level has been proved for 75 ft. A shortage of power furnished by the electric companies has curtailed operations at the Kerr Lake. The mine is being run with the company's air compressor at a rate sufficient to pay dividends. The drainage of the lake is proceeding slowly. The Trethewey has taken a twelve months' option on 120 acres of conglomerate in Harris township in what is known as the Casey-Cobalt section. The annual report of the Beaver covering the year ended February 28 shows that the company shipped 762,698 oz. valued at $438,552, as against 689,921 oz. of the value of $409,212, the previous year. Ore ready for the mill with a content of $192,150 has been accumulated underground. The amount at the credit of the profit and loss account, exclusive of ore, is $299,942.

Porcupine.—The third annual report of the Dome Mines for the year ended March 31, 1914, issued on May 13, caused some disappointment, owing to the low grade of the ore reserves. The tonnage of the reserve has been largely increased during the year, and is estimated at 2,512,600 tons of fully and partly developed ore above the fifth level at 420 ft. vertical, the gross value of which is put at $9,500,000, or an average of $3·80 per ton. This estimate does not take into account two of the present levels, other sections of the property, and what ore may be found at greater depth. The tonnage milled during the year was 145,305, of a total content of $1,272,598, or an average of $8·77 per ton, and the total recovery was $1,204,598 or 94·51%. The total cost per ton milled was $4·19. The consulting engineer, W. W. Mein, considers that when the enlarged plant goes into operation the working cost can be reduced below $2·50 per ton. The deposit of low-grade ore should be worked by a policy of non-selective mining, which on the new basis of treatment capacity gives assurance of a profitable life. He states that the economic advisability of further increasing the treatment plant cannot be satisfactorily determined until additional development work has been done in the lower levels of No. 2 shaft, and the limit of low operating costs has been firmly established with underground mining conditions. The profit and loss statement shows net earnings of $591,779, or about 18% on the capital. After deducting $134,083 for depreciation, &c., a balance of $457,695 was carried forward. Important changes will be made in the Dome milling process. In place of an all-slime treatment a combined sand-leaching and slime process will be adopted. The ore will be crushed by 80 stamps and ground by 5 tube-mills. The product will then be distributed over 24 amalgamating plates, from which half the gold is to be recovered. The product will be classified into sand and slime by hydraulic classifying cones. The sand will be delivered to six cyanide vats, each 40



Western Part of Porcupine District

ft. in diameter by 8 ft. 6 in. deep. The slime will be treated in the existing plant of Pachuca vats and Merrill presses.

The regular 4-weekly statement of the Hollinger for the period ended April 22 shows profits of $135,523, and a surplus of $786,970, an increase since January 8 of over $86,000. The content of Hollinger ore milled was $194,096, of which $184,686, or 95·1% was recovered. The diamond-drill has brought up gold-bearing quartz from a depth of 2000 ft., which is stated to be the greatest depth at which gold has ever been found in Canada. Drilling is being continued for another 1000 ft. The general manager, Percy A. Robbins, has returned from a tour abroad, and is again in charge of the property. The McIntyre treated 4200 tons during April, with an average yield of $10·70, and shipped $46,100 in bullion. Additional plant has been ordered that will increase the production to 300 tons daily. The directors of the McKinley-Darragh of Cobalt, recently paid a visit of inspection to the Jupiter, on which they hold an option. The main ore-shoot on the 300-ft. level has been developed for 300 ft., averaging 42 in. of ore running $15 to the ton. The Plenaurum plant, including a 10-drill compressor, has been rented to continue development. The sale of the Rea Consolidated to the Mines Leasing & Development Co. has been ratified by the shareholders, who will receive 250,000 shares in a company to be organized with $1,000,000 capital to develop the property. The Vipond, or Porcupine Gold property, has been taken over by a new company known as the Porcupine Vipond with a capitalization of $1,500,000, the shareholders receiving 750,000 shares and the right to subscribe for 300,000 more at 30 c. per share. The reconstruction of the mill will be commenced immediately. The Foley O'Brien has made a good strike at the 250-ft. level in No. 2 shaft, the vein being 20 ft. in width, and carrying visible gold. The Porcupine Crown treated 3500 tons of ore in April of an average assay-value of $18 per ton with 97% recovery. The main vein dipped out at the 450-ft. level, and a vein struck on the 500-ft. level was found to carry ore of much lower grade, leading to the belief that it is not the same vein.

Gowganda.—Electric power is supplied to the Miller Lake-O'Brien mine from its plant on Gowganda lake, where about 500 h.p. is being generated. The company has now ready for shipment 20 tons of ore running 5000 oz. to the ton, extracted from the 250 and 300-ft. levels. Surface work has uncovered a good vein in the south-east corner of the property, which shows 5 in. of plate silver for 8 ft. The district is badly handicapped by the lack of transportation facilities.

The Calgary Oil Strike.—Great excitement and a time of wild speculation is reported at Calgary, as the result of an oil strike at the Dingman oil well near Okotoks, about 36 miles to the south of Calgary. This is the first genuine strike of oil in the Calgary field, previously reported finds being merely seepages. There has consequently been a rush to invest in the numerous oil companies which have been recently started. The stock of the Calgary Petroleum Products Co., on the news of the discovery, jumped from $12·50 to $200 and over per share, and many new companies have been organized to take advantage of the boom. J. S. Dennis, assistant to President Shaughnessy of the Canadian Pacific Railway, which as an extensive landholder is largely interested, states that there is no doubt that a genuine strike has been made, there being

2000 ft. of oil in the 10-in. hole at the last measurement made by the department officials, and this oil is shown by analysis to be of exceptionally high grade. The press are publishing the usual warnings against rash speculation, and the purchase of shares in wild-cat companies, which will, of course, fall upon deaf ears. The province of Manitoba, however, has taken more effective action to protect the public. Judge Robson, public utilities commissioner, has refused the brokers who came down from Calgary with oil stocks permission to do business. No Calgary stocks can be sold in that province until the companies satisfy the judge that they have a bona fide well and that the stock is not speculative. They must submit a financial statement showing that the enterprise is on a sound basis, and not until these safeguards have been furnished can they obtain the certificate necessary to enable them to dispose of stock. The example of Manitoba might well be followed by other provinces.

CAMBORNE.

Grinding-Pans.—It is claimed by E. S. King that the grinding-pan manufactured by Head, Wrightson & Co. and recently installed by him in the new Carn Brea mill shows a distinct advantage over the tube-mill in the treatment of tin ores, inasmuch as it does not produce so much slime. In the barrel pulverizer so generally used in Cornwall, there can be no question that a large proportion of slime is produced, which it is difficult to concentrate. In the pan in question unnecessary sliming is avoided by automatically discharging the smaller-grained tin, and not, as in the case of a barrel pulverizer, permitting it to be further reduced in fineness. Some tests at Carn Brea to determine the grinding capacity of the pan and the rate of concentration of mineral in proportion to the period of operation on a given feed resulted as under:

Feed 27 tons per day	%	Discharge %
On 20 mesh	3·9	Nil
40 ,,	49·6	Nil
60 ,,	21·87	·78
100 ,,	20·31	8·2
150 ,,	1·17	28·12
thro' 150 ,,	3·12	62·89

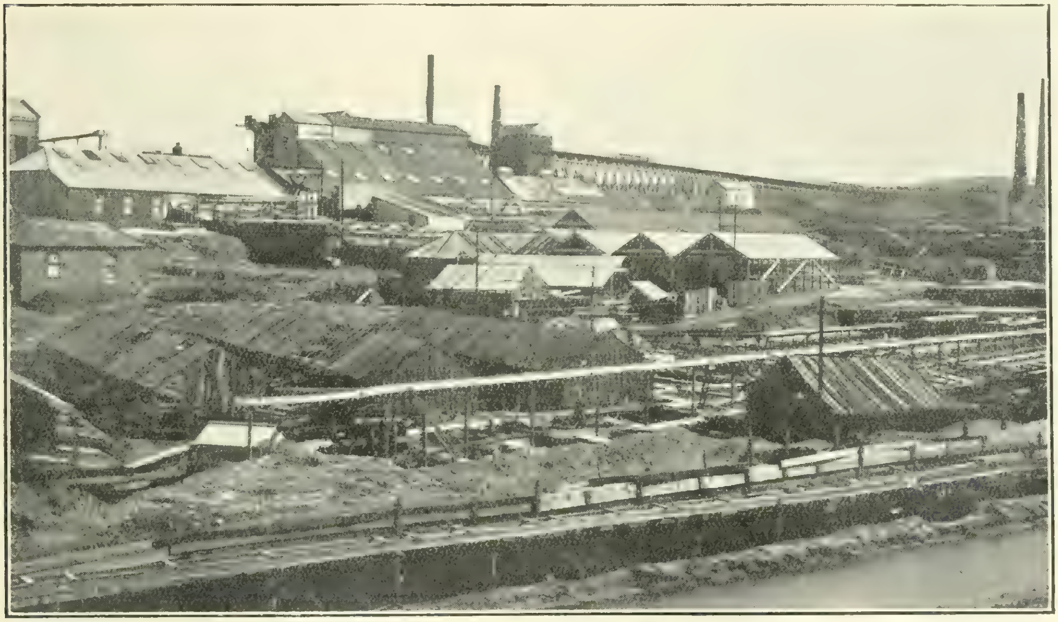
Horse power consumed 6·5.

The product through 150-mesh, after decanting, proved to contain little absolute slime, that is, 'float slime.' Tests over one month showed that on a feed averaging 9 lb. black tin per ton, nearly 28 lb. of black tin per pan was saved, the greater part of which would, in a barrel pulverizer, have been too finely slimed to be caught by any concentration method.

Carn Brea & Tincroft.—Nothing more has been heard of the provision of additional capital for these mines, and no doubt the severe drop in the price of tin has closed the negotiations which Mr. King had in hand, and which a contemporary assured its readers a long time since had been all but successfully completed. It is evident from the monthly returns that the grade of the ore sent to the mill has been substantially improved the last few months. Indeed, it now appears to average 23 lb. of metal per ton as against 18·17 lb. for the six months ended December 31 last. The loss too has been materially reduced, being only £1720 for the sixteen weeks ended May 2 last, according to the reports issued. But for the heavy depreciation in the price of the company's principal product, the mine would now be paying its way.

Geology of Camborne Lodes.—In my April letter I referred to a suggestion made by W. J. Loring at the annual meeting of the East Pool & Agar shareholders to the effect that the mineral 'lords' of this district should have complete surveys of the existing mine workings made on a common base, to be supplemented by a report from a geologist, his idea being that such plans and report would form a basis on which the mines could conduct their future development policy. I then expressed a disbelief in the 'lords' adopting the suggestion, but added that if only a Chamber of Mines existed, such a proposal might have received consideration. Now I hear that the Cornish Institute of Engineers, which has hitherto confined its activities to the discussion of technical papers, has decided to take up the consideration of Mr. Loring's suggestion with a view to seeing if the mining companies, failing the landlords, would combine to meet the cost. The special committee appointed is a representative one, and if only the Dolcoath and Carn Brea officials, who have hitherto held aloof from the Cornish Institute of Engineers, will co-operate, I feel sure that this valuable suggestion would have a real chance of adoption.

Mining Regulations.—The Cornish Institute of Engineers has also appointed a committee to consider the existing Metalliferous Mines Act regulations with a view to improving some of them and introducing new ones. It is to be hoped that the committee will not overlook the urgent need of getting altered the existing ridiculous regulation which prevents cases of more than 4 lb. of explosive substance from being taken underground, a breach of which regulation resulted in a well-known Cornish manager being fined recently. The standardization of all general rules applicable to mines, and the provision of a standard code of shaft-signals, are matters with which the committee will also, presumably, deal. It is satisfactory that the Institute is extending its work in the ways indicated; there is need for co-operation between the mines on many matters, and the Institute, in the absence of a Chamber of Mines, may well act as the medium.



THE EAST POOL MILL.

Concentration at East Pool.—The modified Wilfley tables, mounted on wooden spring-laths after the manner of Buss tables, are giving great satisfaction at the East Pool mill. The saving in power is 50%, in first cost 25%, and in upkeep 30%. The speed can be made much higher, the rate being 320 r.p.m., and the capacity is greatly increased. The material on which they are working is roasted slime carrying 70 lb. black tin per ton. The concentrate averages 503 lb., the middling 45 lb., and the tailing 23 lb. This corresponds to a recovery of 70%, a much higher figure than obtained before.

Dredging for Tin in St. Ives Bay.—The Board of Agriculture & Fisheries has decided that it is inadvisable that a licence should be granted to dredge for tin in the southwestern portion of the bay, a concession sought by C. V. Thomas and strenuously opposed by the local fishing interests as referred to in my January letter. With regard to the applications to dredge in the eastern and northeastern parts of the bay, the Board is of the opinion that operations should at first be of an experimental nature, but the conditions imposed are so stringent as to probably prohibit profitable dredging operations. The fishing interests are, of course, jubilant that their opposition has been so successful, and I fear that the "£20,000,000 worth of tin," the minimum figure put by C. V. Thomas as the value of the tin sand lying in the bay, will never find its way to the smelting works.

Tresavean.—It is reported that the vigorous development of this mine in depth is giving satisfactory results. Harvey's shaft on the main lode has been deepened to the 320-fathom level, at which depth a station has been cut and a cistern is to be installed. The water will be elevated to the 248-fathom level station, at which depth the main pumps are situated. The lode is being opened on the 320-fathom level, and it is hoped shortly to intersect a shoot of tin ground that was highly productive in the levels above. The erection of the Nissen stamps and James tables is proceeding satisfactorily.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

May 1914	April 1914	May 1913
£63. 5s. 10d.	£64. 17s. 4d.	£68. 18s. 9d.

The market has had a gradually declining tendency throughout the month. Business is slow and enterprise has been stifled beneath the many discouraging influences that have so long prevailed. The view is becoming general that the production of the metal is more than the world's needs. Statistical figures scarcely support the belief, although stocks again show moderate increase, for a stock of one month's consumption is not more than a reasonable margin. Manufacturers have become timid in buying and complain that while their present orders will keep their works occupied for some time, no new orders are coming forward. In America, on the other hand, trade is still slack despite the promise which the prospect of a good harvest gives of future prosperity. The lengthened abstention of buyers has impelled refiners to lower their prices, and electrolytic copper is being sold at £65 in Europe with only a small volume of business passing, and in America at 14 cents. With the extreme pessimism that prevails, prices may be said to be holding their own with notable steadiness, but present conditions give little hope of an immediate revival of activity. The more distant future certainly looks promising, and it will be surprising if a general revival does not take place in the latter half of the year.

TIN.

Average prices of cash standard tin:

May 1914	April 1914	May 1913
£150. 19s. 3d.	£164. 3s. 7d.	£224. 14s. 3d.

Even now the decline in prices of this metal shows no pause, and extreme weakness has developed with only short periods of partial recovery. It is certain that very few mines are showing a profit, but even so production cannot be curtailed to counteract the falling consumption. The Straits shipments indeed are large, and the arrivals of concentrate continue unabated. The east is steadily selling regular quantities at under the London parity and there is a large stock of metal held in Chinese ports. The tinplate trade in England is unsatisfactory, and the demand from the United States is in little better condition. The business that is going evokes keen competition on the part of dealers, and sentiment on the market is still distinctly bearish notwithstanding the heavy decline. There must be a formidable stale bull account chiefly on the continent, while London and New York are probably committed on the bear. Prices show a decline of about £17 per ton, and a recovery is apparently not yet in sight. The fear that salvage-lots of metal may have to be thrown on the market acts in restraint of any undue precipitancy in operating for the rise.

LEAD.

Average prices of soft foreign lead:

May 1914	April 1914	May 1913
£18. 4s. 8d.	£17. 19s. 8d.	£18. 14s. 3d.

Prices have fluctuated under the contending conditions of scarcity of supplies on the one hand, and the reported reopening of Mexican smelters on the other. There has been in consequence no very decided tendency until late in the month, when dealers had to cover their sales for May. This led to a squeeze, and the carrying of the position into June at a heavy backwardation. Demand in England has been light, particularly in the building trade, but the continent, and especially Russia, has been an active buyer. Supplies for June onwards promise to be on a more ample scale.

SPELTER.

Average prices of good ordinary brands:

May 1914	April 1914	May 1913
£21. 5s. 9d.	£21. 10s. 1d.	£24. 10s. 4d.

Business has been very dull, following the spurt of buying at the end of April. Galvanizers report some inquiry for distant delivery, but are not covering their requirements for early delivery. The market has been steady at the decline chronicled last month, and will probably remain so. Shipments of galvanized iron show a heavy fall.

OTHER METALS AND MINERALS.

Prices quoted on June 10:

SILVER.—25¾d. per oz., standard.

PLATINUM.—185s. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£81 to £83 per ton.

NICKEL.—£170 per ton.

ANTIMONY.—£28 to £29 per ton.

ARSENIC, WHITE.—£13. 12s. 6d. per ton.

QUICKSILVER.—£7 per flask.

MANGANESE ORE.—8½d. to 9½d. per unit.

IRON ORE. — Cumberland hematite 19s. per ton at mine. Spanish 17s. 6d. delivered.

PIG IRON.—Cleveland 51s. 6d. per ton. Hematite 61s. per ton.

WOLFRAM ORE.—31s. per unit (1%).

DISCUSSION

What is the Grade of a Mine?

The Editor:

Sir—In reading through the editorial notes in your March number, I came across the following:

"The inclusion of 8,550,000 tons of 4·3 dwt. banket is only misleading, seeing that the total cost is equivalent to 5 dwt. per ton. Lack of candour is too kind a term for such indirection."

The above remarks, emphasizing as they do opinions frequently expressed in the Magazine, and by others in even closer touch with actual mine-work, call for critical comment owing to the danger of applying the principle underlying them too rigidly. In considering this principle the question naturally arises: do the words really express the definite opinion that in a working mine all the rock therein must be weighed against the average cost of getting the total tonnage mined? The mere statement of the case in this form is sufficient to show how wrong it is.

Even on the Rand stopes vary, and the working cost in one may easily be several shillings per ton more than in another. Is it therefore logical to assume that, though a hard or badly faulted stope (constituting factors that cannot be evaluated during the developing period) may have a value well above the normal working cost of the mine, it should be included in the ore reserve; while a poor stope in which the ore can be cheaply got, and would in all probability yield a greater profit on working, should be excluded.

In practically every mine it is the good fortune of the management to find hanging-wall or foot-wall reef left in old stopes, which did not pay to take when working costs were high, but now, owing to its situation, it can be got cheaply. Should it be left there because its value is lower than the normal working cost, or should it be taken in order to increase the profit earned? Another instance that illustrates my point is the very common case of a mine having a battery too large for its ordinary requirements. The mine has a complete staff and opportunity is afforded to attack some ground under the normal grade of the mine. What grade of rock can be attacked?

In order to be definite, let us take a concrete example. Let us assume that the mill is capable of crushing 60,000 tons per month, and that it is at present crushing 40,000 tons at a total cost of 19s. 4d. per ton.

The total working cost of every mine is divisible into two portions:

(*a*) An amount that is directly proportional to the tons crushed. This will include miners' wages, explosives, tramming, coal, electric power, and stores generally.

(*b*) An amount that can be regarded as independent of the tons crushed. This will include cost of management, including office expenses, surveyors, samplers, shift-bosses, hauling - engine and compressor drivers, battery and cyanide hands—in fact all classes of labour that would have to be employed if the tonnage were high or low.

From an investigation made by myself, the actual working cost of 19s. 4d., on the above basis, was divided into:

(*a*) Variable ...	10s.	10d.
(*b*) Independent	8s.	6d.
	19s.	4d.

Applying these figures to the case given above, it is obvious that after 40,000 tons of 19s. 4d. grade rock is obtained from the mine in a month, every additional ton having a value above 10s. 10d., and not harder to get than the average, will yield a profit on working.

The question of working cost is also involved in the consideration of this principle, and its absolute dependence on the tonnage crushed is often overlooked. To show how much it does vary, it will be sufficient to take the mine cited above as crushing normally 40,000 tons per month, at a cost of 19s. 4d., and then assume that 60,000 tons is crushed. The new working cost will be arrived at as follows:

	s. d.		£
40,000 at	19 4	=	38,640
20,000 at	10 10	=	10,800
60,000	16 5·7		49,440

The new working cost is 16s. 5·7d. per ton. Therefore on the assumption that the mine can increase its tonnage, without increasing the actual cost of breaking, by 20,000 tons per month, its ore reserve would by value of this fact alone have to be increased by the inclusion of stuff that was hitherto included in the unprofitable section.

Is it not therefore rather harsh continually to harp on the "lack of candour" or "indirection" of mine officials who include stuff slightly below their present working cost, when a slight change in conditions underground may bring it well within the profitable limit.

CHAS. B. BRODIGAN.

Roodepoort, April 23.

Tin Dressing at Geevor.

The Editor:

Sir—I have written the following notes with a view to show that it was probably not the nature of the equipment that caused the alleged failure of the Geevor mill, and that if the machinery had been arranged in another way it might have been more successful. I have used, and am using today Richards-Janney classifiers, Deister slime-tables, and Callow cones for dressing complex tin-ores, and I fully realize their great advantage over machinery more generally employed for this work.

Referring to the flow-sheet of the Geevor mill, as published in the Magazine of December 1913, it seems peculiar that in designing the plant no advantage was taken of an excellent principle, recently introduced by Mr. Josiah Paull and others in Cornish practice. Mr. Paull advocates that the waste or lean material should be discarded at the earliest possible stage in treatment, instead of being ground fine together with the more valuable material, and, after going through the whole milling process, being finally discharged as slime with more tin than it originally contained. The application of this principle has led to coarser crushing in the batteries in Cornwall, and re-grinding a selected portion of the ore only. At Geevor, stage-grinding had taken the place of fine-crushing by stamps, but the first coarse tailing was made on the Deister sand-tables, after passing the ore through the battery, a Hardinge mill, over vanners, and through grinding-pans. As an explanation it is said that it was necessary to use the nine vanners already existing at the plant. If the vanners had been reserved for slime treatment, and instead of the six Deister slime-tables only two had been installed, and four more sand-tables added, the mill could have used the above-mentioned principle at the same cost for new equipment. Judging by personal experience with fine-grained tin ores, I believe that the discharge from the first spigot of the first Richards-Janney classifier must have contained some lean material which would not have paid for re-grinding, and the insertion of a roughing-table in front of the Hardinge mill would probably have been a valuable addition to the plant. That the method of roughing-out a low-grade tailing directly after preliminary crushing should be applicable to almost every tin ore, can be easily understood when remembering that in mining inevitably some waste or very poor material will be broken with the ore. I have concentrated ores that contained some of their tin so finely disseminated that in the *minus* 200-mesh tailing grains of cassiterite with adhering gangue are found, which, according to Mr. H. W. Hutchin, is also the case with Cornish tin ores. Yet I have found it possible in every instance to remove some lean material after preliminary crushing and classification, thereby preventing this material going to the re-grinders and relieving the slime-plant of superfluous load. It may be said that no comparison of Cornish ores with the richer Bolivian ores is possible, but Mr. Paull has proved his principle to be correct by applying it to ore from Cornwall.

Returning to the Geevor plant: instead of feeding the second and third spigot-products from the first classifier to vanners, one Deister sand-table for the second and two more for the third would have given the advantage that a cleaner concentrate than obtained from the vanners could have been made, and in addition, a poorer tailing. The middling and the better part of the tailing from these three tables would have been the correct product to re-grind in the pans. A Richards-Janney classifier can be so operated that the spigot-discharges have absolutely no slime-water; therefore the tailing from sand-tables operated in conjunction with these classifiers can be safely run to waste without incurring the danger of loosing untreated slime. In the Geevor plant, as it has been used, the selection of pans as re-grinders was a fortunate one, because the grinding action of a pan takes most effect on the heavier, consequently the richer material, and many of the lighter and poorer grains escape without being touched. Thereby the system of feeding all the sand to the pans, whether requiring comminution or not, was to some extent favourably counteracted by the selective grinding of the pans.

In the re-treatment section of the mill, the re-ground middling from the first three Deister tables could have been elevated to the second classifier, delivering its spigot-products to two more sand-tables, exactly as was done. The middling of the latter tables might have been returned to the pans, if still containing grains with included cassiterite, or by way of the classifier to the tables if carrying free mineral only. In the latter instance it would not have been at all objectionable to use vanners instead of tables, as only two products are required.

The indicated treatment of sand would have had the advantage, over the system actually used, of making a greater quantity of lean sand-tailing, and cleaner concentrates, and requiring less power and machinery for re-grinding and slime-treatment.

It seems that no equalizing tanks were provided to obtain an even feed from the intermittent discharges from the classifier spigots to the vanners. I have found that a reciprocating sand-table is the only concentrating machine that will endure the intermittent feed without interference with good work. When feeding jigs, vanners, or slime-tables from Richards-Janney classifiers it is necessary to make the discharge continuous.

Passing now to the slime treatment, it is seen that 17·188 tons with 22·3 lb. black tin per ton is run to waste in the final overflow from the pyramidal thickeners (T) without having had a chance to yield their tin on a table or vanner. The system of using Callow tanks in series is partly responsible for this serious loss of 17% of the total ore. When thickening slime, a number of fine grains will never settle unless the velocity of the pulp is reduced to a certain minimum. By passing the pulp through cones in series, this velocity is never attained, and a quantity of fine material flows from one cone to the next, and finally to waste. Cones should be used in parallel, and the feed to every cone so regulated as to give an overflow with a minimum of valuable solids. A Dorr thickener would have been the best machine to settle the slime; it has the advantage of only one apparatus requiring attention instead of many small units. In one of our plants a 30 by 10 ft. Dorr thickener settles about 50 tons of fine slime (over 80% *minus* 200-mesh) per day of 24 hours, giving an overflow of 0·2 grammes solids per litre, and losing only 0·6% of the feed in the overflow.

The following table gives the tin content of the feed and products from the different thickeners in the Geevor mill:

	Cones (E) lb. per ton	Cones (P) lb. per ton	Pyramidal thic'ners (T) lb. per ton
Feed	25·1	17·1	22·0
Underflow	33·3	14·0	12·5
Overflow	20·0	22·0	22·3

It is surprising that only with the cones (E) the underflow is richer than the overflow, and that the settling action in the other thickeners is such as to produce the contrary result. My experience with cones of the Callow type is that the thickened product is in every instance considerably richer than the overflow. For instance: Overflow of 4-compartment Richards-Janney classifier, 3·2 litres per second, 50 grammes of solids per litre, of which 87% *minus* 200-mesh, very clayey ore, fed to two 8-ft. Callow tanks, placed parallel:

	Metallic tin %
Feed	2·2
Underflow	2·7
Overflow	0·9

I have read about a mill at Cobalt where this concentrating action of a Callow cone is utilized to re-treat the tailing from four James slime-tables on one single table of the same type after removing the sandy part and running the overflow from the cone to waste. (See the Magazine for December 1911). In Richards' 'Ore Dressing' Vol. III, page 1404, the following example is given of the work of a Callow cone on Butte copper slime:

	Copper %	Silver %
Feed	2·8	2·81
Underflow	3·5	3·34
Overflow	1·8	2·36

Why do Cornish tin ores apparently behave differently from other ores of tin, silver, or copper?

It is difficult to understand how, when thickening Deister-table middling at Geevor for re-treatment on another table, 5 tons can be lost in the overflow of the dewatering tank. First, I never found the middling-pulp, as coming off the tables, to contain less than 20% solids, so that little, if any, thickening should be required before re-treatment unless a flood of wash-water was used on the tables. Second, this middling gives a pulp, even with clayey ore, that settles easily (30 to 40 mm. per minute); the real slime leaves the table at the lowest tailing side, and is sometimes extremely hard to settle (1 mm. and less per minute).

Summarizing, it is seen that 17·188 tons with 22·3 lb. black tin, and 5 tons with 12 lb. per ton were lost through insufficient settling. On the other hand, material of 14 lb. and 9·8 lb. per ton was thought worth while re-grinding. It would have been cheaper to provide for better slime-settling, thereby bringing material of 22·3 lb. on the tables than to feed them with slime produced by the pans containing only 14 lb.

If Deister slime-tables had been used for the first slime-treatment, that is, the settlings from the two small cones (E), a considerable amount of poor slime-tailing, not requiring re-treatment, could have been made on those tables, and the re-handling would have been confined to the richer middling product only. Supposing that not more than eight Deister tables could be purchased, only two slime-tables would have been available, and these could have performed with advantage the work of the third row of vanners. Nine vanners could then have been used to re-treat the Deister middling together with the slime produced by the pans and the settling from other cones and dewaterers; all this slime could have been given a double treatment on vanners, thereby ensuring a satisfactory extraction.

It may be of interest to mention that, when treating a fine pulp with 2·5% metallic tin on a Deister slime-table, it is possible to discard one half of the material fed with 0·2 to 0·3% metallic tin, leaving only 50% of the feed for re-treatment; at the same time a concentrate of 60% and upwards is produced. The specific gravity of the gangue in this case is 3·5, and 85 to 90% of the pulp passes a 200-mesh screen.

In my opinion the great advantage of the reciprocating slime-table over the vanner for treating tin slime is that a clean concentrate can be obtained that does not need re-dressing, and at the same operation a poor tailing can be run to waste. It is even possible, without great effort, to operate the tables for four products: (1), clean concentrate that might even not need roasting; (2), principally cassiterite with pyrite and a little coarse gangue, which after roasting can be re-dressed with small loss in the refining section of the mill; (3) a middling to be re-treated on other tables or vanners, and (4) a clean tailing. The drawback of this type of slime-table is of course the middling, which is difficult to reduce to the same small tin-content as the tailing, and therefore the last slime-treatment in a tin-dressing plant is perhaps more conveniently done on a vanner. The revolving slime-tables have of course the same property of making several products, but I always found the separation much cleaner on a reciprocating table. Besides, the revolving table uses from 8 to 10 times more water and occupies a great deal more floor-space.

In conclusion, I wish to say that I do not by any means want to endorse the Richards-Janney classifier as the best device for separating a pulp into different grades of sand and slime. In addition to its good features as a classifier, the machine has serious inconveniences: the great loss of mill height,—some 7 ft. in the case of the 4-compartment classifier,—the difficulty of obtaining a clean separation of *minus* 80-mesh sand from slime, and the diluted overflow. Other methods of classification exist that are better, but the Richards-Janney machine is certainly superior to the hydraulic devices that are generally used in tin-dressing plants.

M. G. F. SOHNLEIN.

Machacamarca, Bolivia, April 8.

Hetærolite from Leadville.

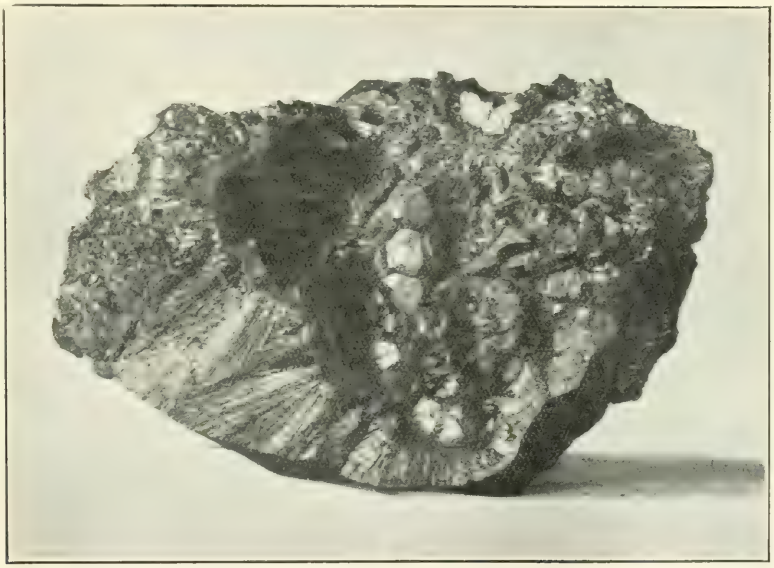
The Editor:

Sir—In my article on Leadville zinc-carbonate ores, published in your April issue, I stated that a new mineral is reported as occurring in these zinc-carbonate deposits, wolftonite, an oxide of manganese and zinc, named after the Wolftone mine. My attention has just been called to the article of Messrs. W. E. Ford and W. M. Bradley in *The American Journal of Science*, June 1913, page 600. These writers show that the alleged new mineral is hetærolite, first described in 1877, by Dr. Gideon E. Moore (same Journal XIV, 423, 1877) as occurring at Stirling Hill, Sussex Co., New Jersey. They compared the hetærolite of Stirling Hill with that from Leadville, and found that the two agree perfectly in all physical and optical tests and the analyses are practically similar. They concluded: "With the evidence at hand, however, the present writers prefer to include the water as an essential part of the composition, making the formula $2\ ZnO,\ 2\ Mn_2\ O_3,\ 1\ H_2\ O$." They describe the Leadville hetærolite as having a radiating mammillary structure, the outer surfaces being generally smooth and rounded. When broken, the radiating masses show a prismatic structure similar to that observed on many specimens of goethite and manganite. Under the microscope, the very fine fragments become transparent, having a dark brown colour. They show birefringence and have an extinction parallel to the prismatic edges. No further evidence of its crystal system could be discovered. The index of refraction was determined to be greater than 1·78, by noting the effect upon the small fragments when immersed in a liquid having this index of refraction. The mineral shows a splintery fracture, a hardness of 5·5 to 6, specific gravity 4·6, lustre submetallic, colour dark brownish to black, streak dark chocolate-brown. The average of two analyses gave ZnO, 37·56; MnO, 50·34; O, 5·99; H_2O, 4·36; SiO_2, 2·69. Total, 100·94. Herewith is a photograph of a recent specimen.

In describing Fig. 4 illustrating hydrozincite in my paper (this Magazine, page 285) I should have stated that the hydrozincite is a film on fibrous smithsonite, both being less than one-eighth of an inch in thickness. So far as my recent observation extends, hydrozincite in the Leadville deposits is more in the nature of a rare mineral than a commercial ore. It, however, occurs as crusts on smithsonite and as nodules in the more oxidized portions of the deposits, but the light-coloured earthy seams mentioned in my article appear to be impregnated clays assaying 10% to 20% zinc. A selected piece of white kaolin-like clay assayed 11·8% zinc. It is highly probable that the zinc in these clays and talcs occur as hydrated carbonate, but I do not feel justified in calling them hydrozincite.

PHILIP ARGALL.

Denver, Colorado, April 23.



HETÆROLITE FROM WOLFTONE MINE, LEADVILLE.

Hydrocyanic Acid and Gold.

The Editor:

Sir—Permit me to add a few words to supplement Mr. Andrew Crosse's letter, in your last issue, upon this matter; I am in full agreement with him, but the statements of fact may be somewhat broadened.

Gold is quite unattacked by a solution of hydrocyanic acid in presence of atmospheric oxygen, notwithstanding the statements of patentees to the contrary. On the other hand atmospheric oxygen may be utilized for the reaction:

$$2\,HCy + O + Au = AuCy_2 + H_2O$$

if certain 'oxygen carriers' be also present in solution, by which the necessary oxidation can be effected. Many such oxygenators are known, a simple type being an easily reducible metallic salt, whose reduction product is again readily oxidized by contact with air. The salts of iron and copper fulfil these conditions in regard to the above reaction, especially in presence of a small quantity of sulphuric acid.

If the experiment indicated by Mr. Crosse be tried in presence of either copper or iron salts, the former being remarkably active, the alternative cyanide reduction and atmospheric oxidation of the metallic salt will be found to bring about sufficiently rapid dissolution of the gold leaf.

Some time ago we based an 'acid cyanidation' method on these facts, which also go far to explain why recent so-called 'hydrocyanic gold-extraction' methods have achieved some success with certain complex and partly oxidized ores, though in other cases they have signally failed. It would therefore appear that where success has been achieved, the sulphuric acid, used to decompose the alkali cyanide employed and in measurable excess thereof, has also dissolved some iron or copper oxide and so provided a sufficiency of an oxygen carrier.

It may be noted that the chlorides of tin and compounds of arsenic and antimony do not act as efficient oxygen carriers for this purpose.

H. LIVINGSTONE SULMAN.

London, May 25.

Klondike or Klondyke.

The Editor:

Sir—*Re* your comments on the spelling of the word 'Klondike' in the April issue of *The Mining Magazine*, page 242, the official spelling of the name is as given above: KLONDIKE. You will find it on page 92 of the 12th Annual Report of the Geographic Board of Canada, 1913, the final authority on Canadian geographic names. The board ruling also specifies — not KLONDYKE, CLONDYKE, or THRONDIUCK.

ALFRED W. G. WILSON.

Ottawa, April 27.

Ore.

The Editor:

Sir—Though it was doubtless your intention to close the discussion as to the meaning of the word 'ore' in your issue of April, yet the modification of your definition at the end of your editorial, and also a remark in a footnote to a letter from a correspondent in your May issue, are of such importance in their effect in clearing the air and in the removal of much mutual understanding that, in my opinion, a re-statement of the case under the modified circumstances is highly desirable. With regard to the new definition, it appears to me that your substitution of "economic advantage" for "profit" removes the cause for objection that many of your critics have urged, and that the words: "Ore is metal-bearing rock that can be exploited to economic advantage" provide an admirable compromise that should prove acceptable to your opponents. The difficulty of fixing the exact meaning of the word 'profit' is so great, and the making of a profit or loss depends on so many accidental circumstances, that to some of your readers it has seemed advisable to eliminate the word and the idea entirely. Nevertheless the practical man knows perfectly well at the back of his head that the word 'ore' is a miner's term and not a mineralogist's, that it really means something that will help him to make a living; in other words that it involves the commercial notion. Some of our friends have quoted Von Cotta's as the simplest of all definitions, the most easily applied, and devoid of any reference to profit or economics; but by a closer consideration of his words: "Minerals and mineral aggregates which from their metallic contents attract the attention of the miner," it is possible to prove the identity of ideas of Von Cotta and yourself. Von Cotta expressly refers to the "attention of the miner." Now a miner is a man who wants a mineral deposit that will provide him with a decent living. If a block of "unprofitable ore" in a mine on the Rand were offered to a contractor on terms dependent on the financial result of its extraction and reduction, it would not "attract his attention." He would promptly and with some vehemence say it is not 'ore,' and if he were a Cornishman his characteristic difficulty with the letter 'h' might provide the necessary objurgation.

The second point to which I referred at the commencement of this communication refers to your remark in the footnote to Mr. A. E. Gregory's letter in the May issue. Your words are: "It is difficult to distinguish between what is ore and what is not ore; that is why mining engineers are employed by non-technical persons. To ascertain whether a mineral is ore is the preliminary step in all intelligent mining operations." It seems to me that this is a view of the matter that deserves amplification, for a due appreciation of it will go far to remove other objections that have been raised. Your words bear the acceptable interpretation that it is allowable to use the word 'ore' before the results of mining and reduction have proved the profitableness of the deposit. This was the burden of Mr. D. A. Louis' contribution to the discussion, for he asked for a word that could be used before the profitableness was ascertained in practice. To be allowed to call material 'ore' on the word of an experienced engineer will tend to clarify many obscure considerations in connection with the application of your definition.

As I said at the beginning of this letter, some additional comment from you on this subject would be welcome.

EDWARD WALKER.

London, May 5.

Future of the Rand.

The Editor:

Sir—Owing to an absence in the West of several months, I have not earlier seen your article in the February issue of the Magazine, entitled 'Future of the Rand.'

In this article you state that "Mr. Leggett demurred to Mr. Hammond's estimated saving of 6s. per ton because he himself was prejudiced against the British administration of the Transvaal."

As you are an engineer writing upon technical subjects I presume it is your object to have always a sound basis in fact for the statements that you make, that it is not your intention to misquote or misrepresent anybody, and that in discussing technical papers it is at least your aim and endeavour to limit the discussion to the technical matters in hand and avoid the introduction of extraneous subjects.

When Mark Twain secured the services of Mr. Dan Beard to illustrate his book, 'A Yankee in King Arthur's Court,' he among other things requested Mr. Beard before he made his pictures to please "read the book."

If you have read my discussion of Mr. John Hays Hammond's paper on 'Gold Mining in the Transvaal,' presented at the Richmond meeting of the American Institute of Mining Engineers, in February 1901, what have you found therein upon which to base your statement that I was prejudiced against the British administration of the Transvaal? In that paper I showed that 61% of the total working costs of the mines on the Rand consisted of the item of labour, the adjustment of which was in the hands of the employers and not in that of the Government, and after quoting Mr. Frank Johnson, writing upon 'Rhodesia: its Present and Future,' I stated: "The foregoing is an excellent picture of the labour conditions in South Africa and shows very clearly where the chief obstacles lie and why they should not be classed as governmental."

I further stated that some reductions would be obtained through governmental economic reforms, but that these would be at least partly offset by an increase in taxation, which I believe has proved to be the case, and I objected to the probability of so large a reduction as 6s. per ton being attained *in the near future*, as prophesied by Mr. Hammond, but pointed out that the experience of all large mining districts was toward a gradual but steady reduction in working costs, and that this reduction might be expected about 1910. I believe it was nearly that date before the actual reduction was attained.

I maintain that the discussion was carried out upon broad and impartial lines, without political bias, and that you have attributed to me a prejudice that did not and does not exist.

THOS. H. LEGGETT.

New York, May 5.

[We are glad to publish this friendly protest. While we had good reason to believe that Mr. Leggett favoured the Boer side of the Transvaal controversy, as he was entitled to do, being an American, we believe that the chief point he wishes to make is that any such prejudice, if existent at the time, did not warp his judgment in a technical problem. That we concede, with pleasure.—EDITOR].

Short Tube-Mills.

The Editor:

Sir—With reference to Mr. A. E. Drucker's letter appearing under the head of 'Short Tube-Mills' published in the May issue of the Magazine, I would point out that the 8 ft. by 30 in. is not the largest Hardinge mill. The Braden Copper Co., The National Copper Co., and the Winona Copper Co. have been operating Hardinge mills 8 ft. diam. by 36 in. length of cylindrical portion for some time, and at the new 600-ton plant of the Inspiration Copper Co., 8 ft. by 48 in. and 10 ft. by 28 in. mills are in operation.

Concerning Mr. Drucker's suggestion of an 8 ft. diam. by 6 to 8 ft. tube-mill as an alternative, the following is worthy of note: The San Poil Consolidated Co., of Washington, installed an 8 ft. by 7 ft. short tube-mill, but after operating it for a short period the management reduced the diameter to 6 ft. by re-lining the interior, owing to the excessive horse-power absorbed.

Your correspondent further asks "Is there really any advantage gained by a departure from the cylindrical type of tube-mill?" The following instance will, I think, provide a conclusive answer: The Federal Mining & Smelting Co., of Idaho, installed a 7 by 12 ft. tube-mill in 1913 to compete with the Hardinge mill in their Morning plant. This tube-mill was subsequently converted to a Hardinge mill by bolting heavy timbers inside the mill, and forming two cones. Steel rails were then spiked to the timbers to form a lining resembling the El Oro type. The converted mill effected a saving of 14% in horse-power and gave a more desirable concentrating product. The converting of this mill was covered by licence granted by Mr. Hardinge.

J. C. FARRANT.

London, June 5.

PERSONAL.

LAWRENCE ADDICKS is investigating copper-leaching methods for Phelps, Dodge & Co.

SYDNEY H. BALL has been in Belgium and is going to Greenland.

WALTER BROADBRIDGE has returned from the Braden mine, in Chile.

C. C. BROADWATER is here from San Francisco.

J. W. BRYANT has been appointed resident manager of the Spassky copper mine.

W. A. CARLYLE is in Spain.

H. C. H. CARPENTER is at present touring the Nevada and Montana metallurgical centres.

VAL E. DE CARTERET left for Russia on May 15.

W. R. H. CHAPPEL is here from the Malay States.

A. G. CHARLETON leaves for Christiania, Norway, on June 27.

H. N. G. COBBE has left for British Guiana and expects to be away three months.

MAURICE L. COCKERELL has returned from Uruguay and has gone to Arizona.

J. PARKE CHANNING has moved his offices to 61 Broadway, New York.

E. H. CLIFFORD is consulting engineer to the City Deep.

NELSON DICKERMAN, manager of the Pato mines in Colombia, left London on June 2 for New York and San Francisco.

G. W. EDWARDS left on May 22 for the Primorsk district of Siberia.

KARL EILERS, J. PARKE CHANNING, and ARTHUR S. DWIGHT received honorary degrees on the occasion of the Columbia School of Mines 50th anniversary.

JOSEPH EMBLETON has been appointed manager of the South Kalgurli mine.

H. W. FAULKNER, chief engineer for the Mexico Mines of El Oro, is in London.

R. H. FERNALD is examining European methods of utilizing gas in metallurgical operations for the United States Bureau of Mines.

J. G. FOLEY is here from Nigeria.

GWYNN G. GIBBINS is examining properties in Northern Canada.

RICHARD HAMILTON has been elected president of the West Australian Chamber of Mines for the seventeenth time.

H. W. HARDINGE is about to go to Alaska to conduct a test for the Alaska Treadwell group.

JAMES HEBBARD, of Broken Hill, is making a tour round the world.

J. A. L. HENDERSON has left for New York on his way to Canada.

E. MACKAY HERIOT has gone to the south of Spain.

J. P. HUTCHINS has returned from the Altai, Siberia.

J. M. ILES is here from Nigeria.

W. SHERWIN KNIGHT has gone to Northern Nigeria.

STEPHEN J. LETT is at Ekaterinoslav in Southern Russia.

FRANK C. LORING left for Canada on May 23, having recovered from an operation.

HORACE G. NICHOLS has returned from America.

PETER N. NISSEN has returned from the United States and Canada.

RICHARD A. PARKER has changed his office to 802 Equitable Building, Denver.

R. W. RAYMOND delivered the commemoration address at the Colorado School of Mines in May.

ALEXANDER RICHARDSON, president of the Chemical, Metallurgical, and Mining Society of South Africa, is returning to England next month.

L. D. RICKETTS has returned to Arizona from New York.

W. E. SIMPSON has returned from Mexico.

EDGAR F. SMITH has been awarded the Elliott Cresson medal of the Franklin Institute in recognition of his work in electro-analysis.

H. HARDY SMITH has gone from New South Wales to Korea.

WALTER J. STANFORD is at the Oulaine copper mine in the Yenesei district, Siberia.

W. F. STEVENS has gone to Russia.

BRADLEY STOUGHTON is on holiday in Europe.

JOSEPH STRUTHERS has been appointed second vice-president of the Johnson Electric Smelting company, New York.

G. GORDON THOMAS has obtained a position with the Anglo-Continental Mines in Northern Nigeria.

J. B. TYRRELL is making an inspection in British Columbia.

W. WALKER has been appointed Deputy Chief Inspector of Mines at the Home Office.

R. C. WARRINER has been appointed consulting engineer to the Crown Mines, retaining the position of general manager.

MORTON WEBBER is in Nevada.

A. S. WHELER has left for China.

H. A. J. WILKENS has returned to New York.

HORACE V. WINCHELL returned to New York on June 6 after a visit to England and the Continent.

GEOLOGY APPLIED TO MINING. I.

By T. A RICKARD.

*MINING is an ancient art; geology is a young science. Man had hardly ceased to be cousin to the ape when he began to dig the ore from which to obtain the metal required to fashion his primitive implements; but human beings had developed all the essentials of that complex mode of living we call civilization before the search for minerals was aided by accurate knowledge.

Geology was cradled in Lyell's 'Principles,' first published in 1830. Lyell gave form and substance to an earlier recognition, by Hutton, that the present is the key to the past, that the unknown can only be explained in terms of the known, that the earth is "her own interpreter" to those willing to study the testimony of the rocks. Thus Lyell gave a great impetus to the systematic study of geology. He did more; he gave powerful aid to the establishment of the central doctrine of evolution as enunciated by Darwin, Spencer, and Huxley. From that time geology became more than a hobby for amateurs, it became an integral part of natural philosophy. But as developed in England the young science was mainly concerned with stratigraphy and paleontology; as yet its economic function was not realized, except in a few beginnings of investigation into the nature of ore deposits, by De la Beche, Henwood, Fox, and Phillips.

In Germany, Werner laid a foundation for genetic principles and advocated ideas that influenced an entire generation of observers. He held that mineral veins, no less than dikes of eruptive rock, were the result of chemical precipitation from the ocean. Thus he was as extravagant on one side as Hutton was on the other, for the latter regarded both kinds of veins, that is, lodes and dikes, as due to the introduction of igneous material. Hutton and Werner each grasped a truth and halved it by a generalization. Werner's theory was made known in 1791, the English translation appearing in 1809. Fifty years later, Von Cotta published a treatise summarizing the views of the Freiberg school, based upon observations in the Erzgebirge. He emphasized unduly the importance of the fissure-vein as a type of ore deposit, and thereby became godfather to many narrow conceptions of ore genesis. In 1878 Von Groddeck recognized numerous types and broadened the fundamental principles.

Another wave of scientific interest in the subject was created by the publication, in 1882, of Sandberger's thesis advocating the theory known as 'lateral secretion,' that is, the derivation of the mineral constituents of an orebody from the enclosing rock. At the close of his essay[1] he stated: "Those who desire to refute the leaching theory will find it necessary, after providing for purer material, to carry out chemical investigations extending over years. Nothing is to be gained by objections not resting upon chemical facts." Thus the chemical study of ore deposits was accentuated, as against the physical and structural. Sandberger imputed the ore in lodes to the results of leaching from the immediately encasing rock. His views were combated successfully by Stelzner and Posepny.

The study of ore deposits for a hundred years owed its progress to German research. In England the detection of fossils and correlation of strata absorbed the attention of geologists to the exclusion of investigation into the nature of those mineral aggregates that are the object of mining. Indeed, not only did geology give the cold shoulder to mining, but when geologists condescended to be interested in mineral deposits, they made blunders highly perplexing even to such as were willing to accept scientific aid. Thus Murchison rashly enunciated the generalization that the Silurian rocks were particularly favourable to gold veins, basing this broad statement on his knowledge of the Ural region; and when gold was discovered in Australia in slate and sandstone of Silurian age, he congratulated himself on the confirmation of his dictum.[2] Later, he interpreted the scanty data at his disposal as warranting "the inference that deep mining in the solid quartz rock is usually unprofitable." No wonder the miner looked askance at the geologist, so that there was a lack of co-operation between the young science and the venerable industry. Moreover, the idea

* The first of a series of five lectures delivered at Harvard University in May 1913, and at the Royal School of Mines in January 1914.

[1] 'Untersuchungen über Erzgänge.' By Fridolin Sandberger. Wiesbaden, 1882.

[2] 'Siluria.' By Sir Roderick Murchison. 3rd Edition, page 474. See also 'The Geological Distribution of Gold.' By T. A. Rickard. *Mining and Scientific Press*, October 20, 1906. Page 477.

obtained in England that geology stooped to commercialism when she concerned herself with mining.

The notion long persisted that science suffered by becoming utilitarian; the geologist deemed hunting for fossils more becoming than the search for ore; and this tradition in effect prevented English geologists from attempting to unravel the complexities of ore occurrence. A notable example is afforded by the Geological Society. This organization was founded by the fathers of modern geology, and in its records will be found the presentation of the principles that constitute the very foundations of the science to the advancement of which the Society is dedicated. Yet the sum total of information concerning ore deposits to be found in the journals of the Geological Society is negligible. Englishmen as geologists occupy a position second to none; as contributors to the study of ore deposits they are nowhere. And this result is not due to the want of subjects for investigation nor to the lack of an important mineral industry, for in the last hundred years the mining districts of Great Britain and Ireland have afforded plenty of opportunity and adequate incentive for the economic application of geology. No; I impute the poverty of result entirely to the fact that men of culture formerly deemed it undignified to make commercial use of scientific knowledge. Only within the last ten years have we been able to point to useful work in this branch of science by Englishmen, among whom I may name Maclaren, Gregory, Halse, Hatch, and Horwood.*

Thus Englishmen founded geology, and Germans started the systematic study of ore deposits; but it was in America that economic geology won proper recognition. To the United States Geological Survey we owe much pioneer work in this department of human knowledge. From its inception under Clarence King, in 1879, the Survey has given the warm grasp of friendship to the miner; and during the last thirty years the scientific men of the Survey have contributed an entire literature on the systematic study of ores and metals as found in nature. In monographs, reports, and bulletins innumerable, the officers of the United States Geological Survey have published detailed descriptions and profoundly suggestive conclusions covering most of the mining districts developed within the wide borders of the American continent. The area involved and the diversity of conditions illustrated have been such as to check narrow views; indeed, the variety of ore occurrence has afforded a liberal education to the American geologist, and he has used his opportunity with untiring industry and consummate skill.

Another factor helping the development of this intensely practical branch of geology was the American Institute of Mining Engineers, a society directed for many years by Rossiter W. Raymond, himself a mining geologist of wide experience and a speaker of rare versatility. He did much to bring together official geologists and mining practitioners, so that the meetings of the Institute afforded excellent facilities for the free exchange of ideas on a subject interesting alike to the geologist and to the engineer. The transactions of the Institute became a valuable library of economic geology, and to it the leaders of thought were prompted to contribute their mature convictions.

Thus it was that at three particular periods, in 1884, 1893, and 1900, a general discussion was incited in America by the publication of papers embodying new ideas formulated by geologists of international reputation. In 1884 S. F. Emmons published his monograph on Leadville[1]; this complete treatise on a rich and famous mining district was issued by the Geological Survey; it was an exceptionally successful effort to unravel the underground structure of a region complicated by many faults, and it gave information of immediate use to those in charge of mining operations. This monograph was a superb vindication of the value of geology in mining. The evidence gathered by Emmons led to much fruitful discussion at the meetings of the American Institute, and in 1893 prompted Posepny to contribute a treatise based largely on his own study of the Pzribram mines and those of Transylvania.[2] Up to that time the theories of Sandberger in various guise had found favour, that is, the idea that ore deposits were derived from the wall-rocks of veins by means of the solvent action of waters moving laterally. To this interpretation of the facts as disclosed by mining, Posepny opposed systematic observations, the effect of which was to elucidate the basic idea that neither the lateral, the ascending, nor the descending waters were to be credited with all the work of ore deposition—not any one of these phases of the circulation, but the whole

* Notably J. Malcolm Maclaren's work at Kalgoorlie and Porcupine. See also that author's volume on 'Gold,' 1908.

[1] 'Geology and Mining Industry of Leadville, Colorado.' By Samuel Franklin Emmons. U.S. Geological Survey. Monograph No. XII.

[2] 'The Genesis of Ore Deposits.' By Franz Posepny. Trans A.I.M.E. Vol. XXIII. Pp. 197-369.

of it, as modified by varying conditions at successive periods.

So far, progressive knowledge had come mainly by induction from facts, but an exceptional development of scientific inquiry was illustrated in 1900 when Van Hise contributed a brilliant essay, which was essentially a deductive reasoning from physical and chemical principles.[1] His suggestions proved illuminating along new lines of thought. He took the underground circulation of water as one connected manifestation of natural energy, and from a comprehensive review of the literature then available he emphasized two conclusions: (1) sulphide ore is generally deposited by ascending water; (2) secondary enrichment is affected by descending water. Simultaneously with this pronouncement concerning the origin of the richer parts of lodes, Emmons[2] and Weed[3] published papers explaining how copper deposits became enriched at moderate depth by precipitation of the metal leached from near the surface by descending waters. From lodes of copper the idea of secondary enrichment was applied to deposits of other metals,[4] so that the formation of bonanzas in general became better understood. This, of course, was a great step forward, for it gave the miner a clue to the discovery of the richest ore, which, after all, is the main object of his search.

Thus, at last, geology in relation to mining reached a point where the most uncompromising utilitarian could not refuse to recognize its industrial value. Starting as the science of amateurs, geology in its economic phase had become the technology of workers. And was it debased thereby? Rather let us say that the science was now ennobled by giving help to those who labour in the mine and quarry; from the heights of philosophy, geology had stooped to be of service to humanity, and by so stooping had herself been raised to greater honour.

Before summarizing the conclusions now deemed worthy of acceptance, it is necessary to refer to two of the latest ideas concerning the genesis of ore deposits. While the American geologists were occupied in analysing the effect of aqueous action, a Norwegian investigator, Vogt, was making a careful inquiry into the differentiation of magma—the molten matrix, which, on cooling, becomes the substance of rock.[1] Vogt came to the conclusion that the normal terrestrial water-circulation underground played only a minor part in the primary origin of ore deposits, however much that water-circulation may have affected the later concentration of ore from such portions of the magma as were rich in metals. Kemp[2] applied this idea, and showed how the greater number of deposits containing gold, silver, and copper ores are near igneous rocks, with which he believed them to be genetically connected. Meanwhile, Spurr[3] had become impressed with the evidence of segregation in gold veins and announced a radical departure from accepted theory by describing the gold-bearing quartz veins of the Yukon as representing the last stage of magmatic differentiation. He regarded quartz veins as the end-product of a process that in its final phase is marked by a magma so attenuated as to resemble heated water charged with silica and other mineral matter, including gold. This theory led to researches into the physical effects of metamorphism at the contact of igneous with sedimentary rocks, and yielded evidence of the mineralogic changes induced by intense thermal action. It was shown, by Lindgren[4] and Kemp, that sedimentary strata are made porous by metamorphism, which may be compared in its effects to the results produced by burning clay into brick. The derivation of ore from magma and the activity imparted to the underground water-circulation by vulcanism proved highly suggestive to geologists and to mining engineers.

Thus renewed attention was directed to the igneous rocks as agents in ore deposition, and stress was laid on the part played by magmatic waters, as against the exclusive agency of meteoric waters, that is, the water originating at surface from rainfall. In 1903 an attempt was made to apply these new ideas to the classification of ore deposits in accordance with their supposed genesis, whereupon a lively debate ensued before the Geological Society of Washington. This discussion[5] was inconclusive, as might be expected, for we do not know enough concerning the origin

[1] 'Some Principles Controlling the Deposition of Ores.' By C. R. Van Hise. Trans. A.I.M.E. Vol. XXX. Pp. 27-177.,
[2] 'The Secondary Enrichment of Ore-Deposits.' By S. F. Emmons. Trans. A.I.M.E. Vol. XXX. Pp. 177-217.
[3] 'The Enrichment of Gold and Silver Veins.' By Walter Harvey Weed. Trans. A.I.M.E. Vol. XXX. Pp. 424-448.
[4] 'The Formation of Bonanzas in the upper portion of Gold Veins.' By T. A. Rickard. Trans. A.I.M.E. Vol. XXXI. Pp. 198-220.

[1] J. H. L. Vogt. *Zeitschrift für praktische Geologie*, January and April, 1893; October 1894; April, September, November, and December, 1895.
[2] 'The Rôle of the Igneous Rocks in the Formation of Veins.' By James F. Kemp. Trans. A.I.M.E. Vol. XXXI. Pp. 169-198.
[3] 'Geology of the Yukon Gold Belt.' By J. E. Spurr. U.S. Geological Survey. 18th Annual Report, Part III. Page 300.
[4] 'The Character and Genesis of Certain Contact Deposits.' By Waldemar Lindgren. Trans. A.I.M.E. Vol. XXXI. Pp. 226-244.
[5] 'Ore Deposits. A discussion.' Edited by T. A. Rickard. 1905.

of ore deposits to warrant any final classification. But the attempt disclosed the dark places in current knowledge, and served to distinguish between what we know and what we think we know. Thus science progresses.

This discussion concerning the parts to be allotted, on the one hand, to igneous rocks and the magmatic waters associated with them, and, on the other hand, to the meteoric waters and the vadose circulation, led to a clear appreciation of the importance of an ore-forming agency hitherto not recognized by economic geologists. In successful opposition to Posepny, Van Hise, and other authorities, it fell to Kemp to turn the trend of speculation, and to demonstrate that magmatic waters must be the carriers of the metallic compounds constituting ore deposits. His essay, entitled 'The Rôle of the Igneous Rocks,' published in 1901, drew attention to the dryness of deep mines, "the general absence of water in the rocks below moderate depths, except in regions of expiring vulcanism," and the distribution of mining districts as related to the occurrence of igneous rocks. Attention was drawn thereby to the 'water-level' in mines and the state of diffusion of water in rocks. In 1900, in 1903, and again in 1908,[1] I directed attention to the significance of the evidence afforded by deep mining. Usually when the earth's exterior is penetrated by a shaft the ground is comparatively dry until at a shallow depth, varying from 50 to 300 feet, water is struck. Other shafts in the vicinity will fill with water at about the same depth, so that a 'water-level' becomes recognized. Below this level the water entering a shaft or pit increases in volume until a maximum is reached at six or seven hundred feet. On resumption of sinking, if the water entering the shaft from upper workings be collected and pumped to the surface, the influx of additional water decreases until at 1000 feet, or thereabouts, the ground appears to be dry, that is, no moisture is visible, although the dusty rock may be found on analysis to contain 3% water. This is the general experience of metal mining all over the world; local variations, due to seasonal changes and rock structure, are observed, but they only serve to emphasize the general conclusion that vertical openings into the earth's crust do penetrate below the reservoir or accumulated store of water fed by rainfall. In effect, we have a 'water-zone,' as against the universal ground-water formerly assumed to exist to an indefinite depth; for example, Van Hise mentions 10,000 metres as the limit; others have set even less definite bounds to the extension of the water that is supposed to saturate the rocks in which deposits of ore have been formed.

Obviously, the distribution of water is a vital factor in the processes by which ore is deposited in lodes and veins. To the miner, whose operations are restricted, the ground-water will appear as a zone relatively deep; to the geologist, who views the matter on a larger scale, this zone will appear as a blanket, the top of which is smooth, while the bottom is jagged. Under the water-zone is a region of dry rock, and somewhere below it, at a variable depth, is the source of the magmatic water, the final product of differentiation and the result of chemical change within the earth. This magmatic water does not rise by reason of gravitative stress, nor is it connected with the ground-water; there is a hiatus between the source of the magmatic water and the reservoir of meteoric water. We have a blanket of cold meteoric water subject to local movement; then a region of dry rock, penetrated by fractures, which give passage to the deeper up-welling thermal waters of magmatic origin. From the surface the meteoric waters descend and accumulate at the water-zone, to be returned to the surface in the form of springs and artesian flows. The hot magmatic waters ascend through fractures made by movements due to volcanic action and through fissures caused by readjustments of the earth's exterior, until they reach the upper, almost superficial, zone of cold water.

Geologists have assumed that the mineral-carrying solutions from the depths can pass through rocks saturated with water without losing their identity, that is, they have failed to recognize a fundamental factor in the problem of ore deposition. We might as well imagine a mountain stream entering a morass, passing through the morass, and issuing at the lower end without change of character. Indeed, the water-zone has many points of similarity to a morass, for it is a tract wherein both reducing and oxidizing conditions variously prevail, owing to the presence of carbonaceous matter on the one hand, and of entrained oxygen on the other. Thus it is apparent that the work of the miner has yielded information of the greatest significance in any understanding of ore deposits; in short, inductive inference from facts has served to discipline deductive reasoning from principles.

[1] 'The Cripple Creek Volcano.' By T. A. Rickard. Trans. A.I.M.E. Vol. XXI. Page 377. Also, by the same, 'Water in Veins—a Theory.' *Engineering and Mining Journal*, March 14, 1903. Also 'Waters, Meteoric and Magmatic.' *Mining and Scientific Press*, June 27, 1908.

Accepted ideas concerning the origin of ore deposits may be illustrated by describing briefly the manner in which a simple type of lode is supposed to have been formed. Let us take a gold-bearing quartz vein in granite: the vein occupies a fissure formed by a dislocation connected with the intrusion of igneous rock, which appears elsewhere in the vicinity in the shape of dikes. The quartz contains iron sulphide, as pyrite, which near the surface is oxidized to hematite or occurs in hydrous form as limonite, staining the white quartz red. The gold is found native and in coarse particles at the outcrop and for a variable depth, but below the zone of oxidation the gold is rarely visible, and is associated intimately with the pyrite. Oxidation ceases a little below the level at which water freely enters the mine-opening. At a thousand feet the ground becomes dry and concurrently the vein becomes less rich in gold. At a depth of five thousand feet the quartz carries only traces of gold, but the gold-contents of the vein have not diminished steadily in depth; on the contrary, extreme variation has been noted both laterally along the strike and vertically at different levels. In depth the rock enclosing the vein becomes harder, less fractured, and less moist. The pyrite tends to diminish in quantity. Even the vein-fissure is narrower, as if the rock had squeezed it on either side. The temperature increases at the rate of 1° F. for every 90 ft.; obviously this increment indicates a depth—far beyond the reach of mining—at which the rock will be plastic or subject to deformation, incompatible with the existence of fissures or such other channels as are required for water-circulation.

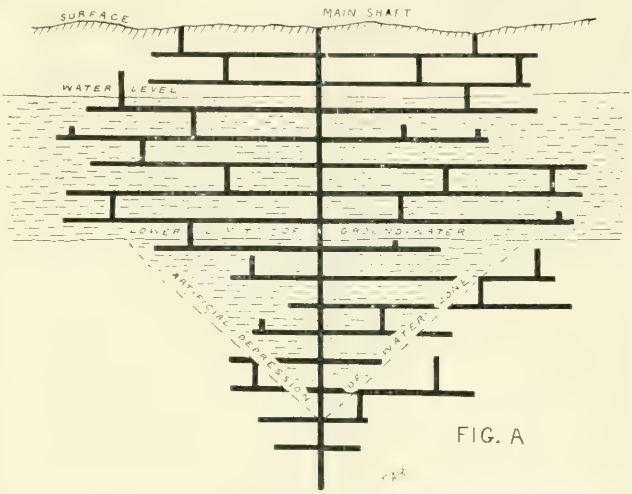


FIG. A

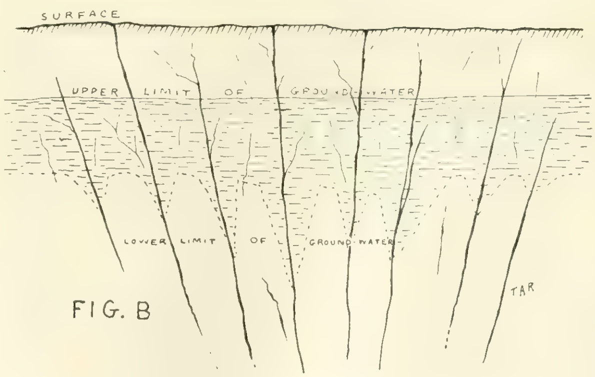


FIG. B

THE WATER ZONE.

Given these facts, let us try to reconstruct the life-history of this gold vein, which is the fossilized remainder of a conduit through which mineralized solutions passed, probably more than once, and for a period so long that as compared to it the time of one of the generations of man is as the life of a spring flower. Indeed, the formation of a gold vein is an example of the cumulative effect of the infinitely little. We assume that the minerals—the quartz, the pyrite, and the gold—were precipitated from solution, but the solution, as compared to that of a chemist in his laboratory, was as weak in its dilution as it was potent in its volume. When a student I heard Judd say, in speaking of the hot spring at Bath, that this, although an unimportant geologic agent, brings daily to the surface 180,000 gallons of water at a constant temperature of 120° F., and as the spring is known to have been doing its duty at the time of the Roman invasion of Britain, it is estimated to have brought to the surface in solution enough material to form a large volcanic cone. But the feeble spring that wells quietly to the surface at Bath is the product of thermal activities almost dead, while the gold vein is the sealed conduit of solutions that pulsated with the very life of the volcanic energy issuing from within the warm heart of the earth.

Our typical vein is in granite, which is also traversed by dikes of andesite. This andesite elsewhere in the district penetrates some of the formations overlying the granite, but the andesite is itself overlain by other more recent sedimentary strata ; thus the age of the dikes is ascertained to be, let us say, early Tertiary. At that time this portion of the earth's crust was subjected to strains, due to the adjustment of a cold exterior upon a cooling and shrinking interior. The adjustment may have taken the form of a slow movement, which folded the yielding sedimentary rocks and cracked the less pliable granite. The granite was fissured down to the molten magma or to a horizon where the substance of this earth is subject to such heat as to remain solid only because excessive pressure prevents liquefaction. As soon as the pressure is diminished, in places and temporarily, by the shifting of the crust and the formation of fissures, the magma becomes molten and rises in the cracks toward the surface. No gaping crevasse is assumed ; the magma or lava follows and occupies the fissure as it is formed. The action may be compared to that of water filling the cracks in a sheet of ice ; and as the water rising through a crack in the ice is referred to the body of water beneath the ice, so we connect the lava in a dike with a magmatic mass under the cold crust of the earth. Thus the dikes were formed.

The period of vulcanism was succeeded by a quiescent stage during which molten lava ceased to issue, to be followed by watery emanations steadily more tenuous until they became essentially only hot water containing silica in solution with traces of iron and gold. This gradation expresses the process at work in the depths, whereby the molten mass undergoes differentiation by segregation of its constituent elements, the heaviest being first to crystallize, followed by others less basic, until finally all of the magma has consolidated, leaving a residuum of hot silicious water.

Meanwhile the granite was still subject to strain and to rupture ; the dikes and other bodies of intrusive rock were cooling, and as they cooled they permitted cracks to be formed, sometimes along the lines of weakness they themselves now afforded. Up these cracks came the final products of magmatic differentiation, namely, the hot silicious waters containing the substances from which the gold vein was to be built.

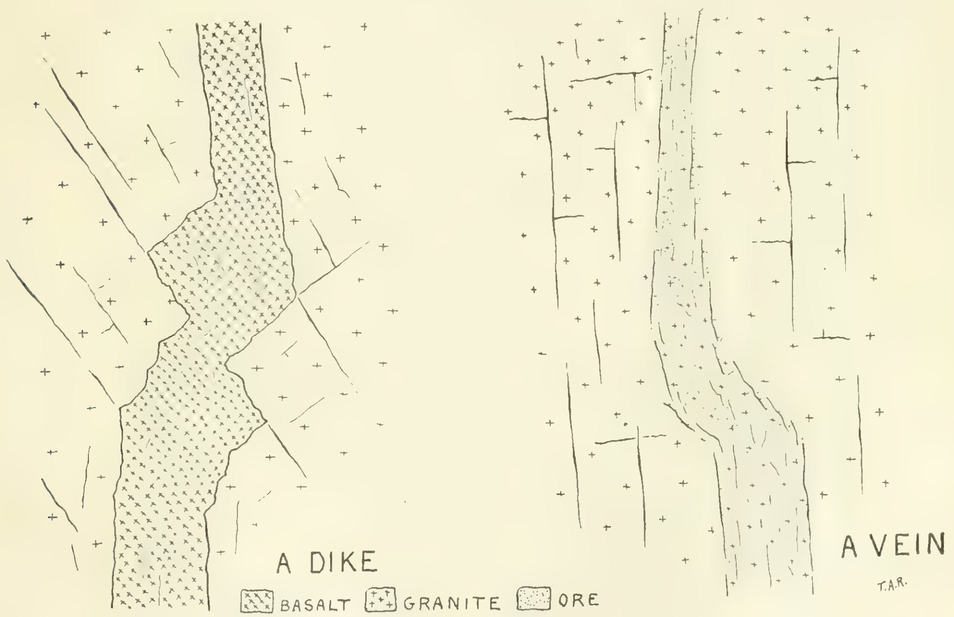
Then supervened a long period of thermal activity, the heated solutions circulating through cracks and fissures after the manner in which hot water is impelled through the system of pipes in a house. Expansion under heat becomes an enormous force through the generation of steam, for one cubic inch of water makes one cubic foot of steam. Indeed, steam is a prime factor in the formation of both dikes and veins. Andesite ordinarily fuses at 2520° F., but it is liquefied at 800° in the presence of superheated steam, the presence of which in indicated by the vesicular structure of lava, as well as by the emission of enormous volumes of water-gas, which forms the clouds of so-called ' smoke ' characteristic of volcanic outbursts. These features are well illustrated in the accompanying photograph of Vesuvius (on page 439).

The question now arises as to the source of the hot waters that made the gold-quartz vein. As previously stated, until recently it was held that all such solutions formed an integral part of the circulatory system originating at the surface from rainfall ; that is, the underground waters were supposed to be of meteoric origin. But the weight of evidence is against such a theory ; we know that in depth the rocks become less open to the passage of water ; the gravitative stress that enables it to sink at the surface is overcome by increase of temperature and by a pressure that tends to close every opening. At a depth measured by about 30,000 feet the pressure and temperature have so increased as to produce deformation of the rock ; hence no openings save of microscopic size are possible. Moreover, at about the same horizon the ' critical point ' of water would be reached. At a temperature higher than 773° F. water cannot exist in liquid form no matter how great the pressure ; it becomes dissociated into its constituent gases. Thus there is a vertical limit to the descent of surface drainage.

Whence, then, comes the enormous volume of water ejected by volcanos and thermal springs ? At one time it was supposed that the sea found a way into cracks leading to volcanic vents, and in a few instances this is believed to have happened to a minor degree, but this simple hypothesis does not explain the emission of equally large volumes of steam in regions distant from any large body of superficial water. Briefly, it is held now that volcanos make the sea, rather than the contrary, that is, that the large bodies of water now covering the earth are a by-product from the cooling magma out of which the planet has been evolved. Thus we look to the depths —not to the surface—for the origin of the thermal waters that formed the gold vein. Regional disturbances had folded and fractured the granite, so as to create breaks reaching into the magma from which the andesite came; and when a renewal of unrest, due to later readjustment, opened fresh fractures extending below the stony exterior of the earth, then the magmatic waters, the end-product of segregation, rose under propulsion of steam until they reached the zone traversed by meteoric water, and forced their way through fissures and fractures even to the surface, where in places they issued forth as geysers, or 'gushers.'

The dilute silicious solutions that thus finally reached the surface had travelled patiently along the underground water-ways, dissolving and precipitating, enriching and impoverishing themselves, under the compulsion of chemical and physical conditions. Hot water under pressure, and especially as superheated steam, is a powerful solvent. At a depth below 10,000 feet and a temperature higher than 212° F., the dark silicates would be readily corroded, and would yield both their silica and their metallic ingredients. The ability to carry matter in solution is increased by heat and pressure until saturation is attained, but at excessive temperatures the rapidity of solution is gained at the expense of stability. Thus at the greatest depth the interplay of solutions is rapid and the result unstable. Selective solution has full play. But as the waters ascend, the pressure decreases; and they become incapable of carrying so much material in solution. Then precipitation ensues. Speaking generally, we may say that in the approach to surface the lessening of temperature and the decrease of pressure favour precipitation; as in depth, with augmented heat and pressure, the reverse action, namely solution, is predominant.

Ore deposition may be regarded as a process of natural concentration; the vein is the repository of substances brought thither from many directions and solidified from solutions of diverse composition. As silica forms 60% of the substance of the earth's outer covering, it is not remarkable that it should be found so plentifully in concentrated form as quartz in veins. But, as the end-product of magmatic segregation, the silicious solutions followed naturally in the wake of eruptive activity and on the wane of vulcanism.



A DIKE AND A VEIN AS SEEN IN THE SAME ROAD-CUTTING, AT CRIPPLE CREEK.

For the iron we may look to the dark silicates, which predominate in basic igneous rocks. The emission of sulphur compounds at volcanic vents points to the existence of that element as an original constituent of deeper rocks. Thus the source of the iron sulphide, or pyrite, is indicated. Such sulphide of iron may be carried in alkaline solutions, in carbonated waters, or dissolved even in pure water. Carbon dioxide in liquid form is found plentifully in the microscopic cavities of rocks, and carbonate minerals are widely distributed. During periods of unrest, when the rocks are fractured, this carbon dioxide is liberated; and when silicious waters penetrate limestone or dolomite, the process of silicification is accompanied by the formation of carbonic acid. Thus a solvent is let loose. It is probable that water rich in bicarbonates, and with an excess of carbon dioxide, was the chief solvent for the iron compounds from which the pyrite originated.

Next, the gold. Gold is widely disseminated in nature; in sea-water, in sedimentary rocks, in igneous rocks, it has been detected, but not until it has been concentrated to a point rendering it worth while to go to the pains of extracting it from its place amid less valuable minerals does the precious metal become of economic importance. The gold in a vein has undergone great and varied vicissitudes; it may have been laid down from magmatic waters that retained it at the end of a long process of differentiation; it may have been leached from the iron and manganese silicates; it may have been derived from deeply buried oceanic sediments; it may have passed through each and all of these stages of existence, but in any case it is likely to have been dissolved, precipitated, re-dissolved, and re-precipitated several times before resting finally at the spot where it is struck by the pick of the miner.

Of solvents for gold there are many: Chlorine is prevalent in nature and is used in metallurgy. Hydrochloric acid is one of the products emitted at volcanic vents. Iodine, which is a constituent of seaweed and exists in oceanic sediments, may have played a part. Alkaline sulphides may be mentioned. Iron persulphate is a possible solvent, in view of the association with pyrite.

When ascending thermal waters containing gold in solution approach the earth's exterior, they become susceptible to precipitation. If highly saturated, the decrease of temperature and pressure is enough to compel unloading of the precious freight. But even for dilute solutions there lie in wait many reducing agents. Organic matter, in the form of carbonaceous remnants of vegetal organisms imbedded in the sedimentary rocks, is one of these. Even pyrite itself is a likely agent in the precipitation of gold. Ferric sulphate is a solvent, but ferrous sulphate is a precipitant. Once the gold is brought to the shallow horizon, and is subject to the divers chemical and physical conditions obtaining within the water-zone, it is the sport of continual change, one effect of which is to produce the concentrations constituting rich ore.*

The gold vein is a victim to nature's mutability. No sooner is it made, than it is attacked by the forces of decomposition and decay. In nature, life and death go hand in hand; integration and disintegration pursue each other eternally. The uppermost portion of our quartz vein is exposed at surface to weathering and erosion. The minute crevices of the white quartz are penetrated by the rain, which, on freezing, serves as a wedge more strong than steel. The maximum density of water being at 39° F., there is a sudden expansion at the moment of solidification, or freezing, sufficient to constitute a powerful agent of disruption. Thus the constituents of the vein near the surface are released for transport in the water-circulation, and merge into the meteoric waters, which, by gravitative stress, pass downward. The weathered cap of the vein remains as a honeycombed vertically tabular body of quartz, impoverished in gold, stained with iron oxide, and loosened by frost. The gold is carried a little deeper, but probably not far; for reducing agents are plentiful and speedy re-precipitation is likely. Thus an enrichment is produced, the gold from the upper part of the vein being superadded to the normal gold content as originally laid down. If, now, further erosion lowers the surface and removes the impoverished cap, the result will be to bring the enriched portion of the vein to the daylight or to the grass-roots, where the adventurous prospector haply may find it, greatly to his joy and possibly to his undoing.

My attempt briefly to indicate the processes by which a gold vein is formed would be misleading if I failed to emphasize the important part played by structural conditions. Deposition of ore is affected by the physical, and also chemical, conditions created by variations of rock-texture, by changes in the width and dip of the vein-fissures, by faults, by crossings with other veins, and by a multiplicity of local modifications such as the miner has a keen eye to appreciate. The scientific man helps to explain them and thereby sharpens the eye of the unscientific to observe them. By furnishing a clue to the vagaries of ore deposition, the geologist gives the miner a key to further knowledge. The key does not always fit the case, but the difference between intelligent and unintelligent observation constitutes the great gift of geology to mining. "Without speculation there is no good and original ob-

*'The Formation of Bonanzas in the Upper Portions of Gold-Veins.' By T. A. Rickard. Trans. A.I.M.E. Vol. XXXI. Pp. 198-220.

servation," so said the author of 'The Origin of Species.' Theories come and go, but the multiplication of facts tends continually to furnish a safer basis for the ascertainment of ultimate truth. We have learned from Huxley that "we ought to exhaust known causes before seeking for the explanation of geological phenomena in causes of which we have no experience"; and we are impressed by a "conviction of the unbroken sequence of the order of natural phenomena, throughout the duration of the universe, which is the great, and, perhaps, the most important, effect of the increase of natural knowledge." This conviction has guided the economic geologist; he has gone from the known to the unknown, from the present to the past, from the volcano in eruption to the solidified lava veining the rocks, from the hot spring bubbling at the surface to the fossilized vent that was once a thermal conduit, from the solutions observed by him in his laboratory to the underground solutions whose activities formed the orebody.

A Volcano in action: Vesuvius, 1906.

Thus illumination has been vouchsafed to the miner. No longer he gropes blindly in the darkness underground, for science has given him a light; feeble it may be as his candle in the gloom of cavernous workings; its rays may not reach far, but at least it will keep his feet from stumbling and his hands from misdirected toil. That is the gift of geology to mining.

THE WOLFRAMITE INDUSTRY OF LOWER BURMA.

Introductory. The Mineral Area. Mining Laws. Prospecting Licences. Surveys. General Geology. Lodes and Veins. Prospecting. Sale of Products.

By HARRY D. GRIFFITHS.

THE literature of wolfram and wolfram mining is scanty and difficult to find. The following notes gathered during a recent extensive trip through Lower Burma may therefore prove of interest.

It is difficult to ascertain the world's production of tungsten ores, but it cannot at the present time be much less than 6000 tons. The demand for the metal during the last two or three years has increased considerably owing to a wider application in the shape of drawn filaments for incandescent electric lamps.

The wolframite industry of Lower Burma is of some importance as shown by the exports from the Tavoy district alone. These have been as follows:

	Tons.	Value. £
1911	1091	79,380
1912	1499	119,971
1913	1508	130,765

The part of Burma that produces the major portion of the ore is the Tavoy district in the province of Tenasserim.

The town of Tavoy, one of the oldest British settlements in Burma, is situated 30 miles from the mouth of the Tavoy river, the course of which is north and south, practically parallel to the coast. It is not connected by any road or rail to the chief towns in the vicinity, Mergui to the south or Moulmein to the north, and can only be reached conveniently by local steamers running from Rangoon bi-weekly.

The run from Rangoon to the mouth of the river is accomplished under 24 hours, and, if the tide suits, the steamers go up some 6 or 7 miles farther. There they anchor in the wide river with low and extended banks, and a noble and imposing background, east and west of the jungle-clad mountains of the mainland and of the Tavoy promontory. The cargo is transferred to native sailing-boats which eventually run up the river, and all the passengers, including hordes of natives, are transhipped to a generally much overcrowded paddle-launch, having a freeboard of at least six inches, to await the ebb tide before it can venture to face the numerous shallows and sand-banks distributed over the 21 miles to Tavoy. If you are not in a hurry to reach your destination you will probably get there in some 3½ hours, but if some special business makes your arrival there at a fixed time imperative, it is almost certain that the shallows will have their say in the matter and will hold you fast until the next rising tide.

On arrival opposite to Tavoy, you are taken ashore in sampans, or Chinese row-boats, as there exists no jetty or any kind of accommodation for landing; and you must be wary, when you land on *terra firma*, as you may either sink to your knees in mud, or else slip on the muddy inclined plank-way and toboggan gracefully into the pea-soup river. This lack of any provision for landing goods and passengers is very striking and gives a sharp blow to preconceived ideas, gathered from experience in other even more remote parts, of British progress and enterprise. The Government has taken many years to consider the advisability of constructing a jetty, but conflicting opinions in the principal Government departments result year after year in a deedlock. It is pleasing to hear, however, that those differences have now been smoothed over, and that the project has been decided upon, and that work will be commenced with the greatest despatch compatible with the dignity of a Government department.

At present all goods and machinery have to be of strictly limited weight, as they must be rolled off the boats on to, and up, the mudbanks. Under the circumstances, those who would be inclined to use machinery have to pause before the difficulty of landing it, or else be compelled to use small and inefficient units.

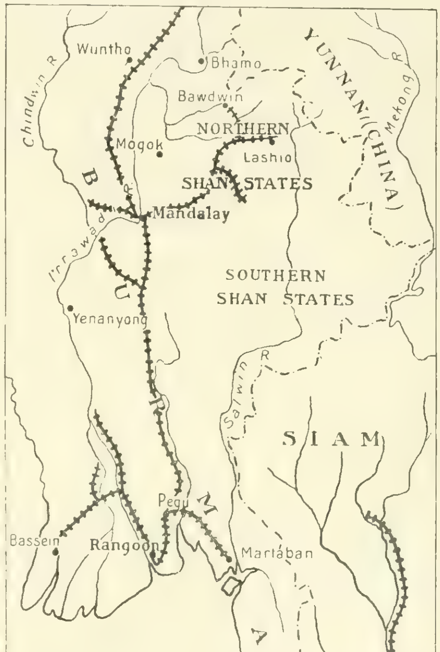
When you have safely landed, you generally put up at the Municipal Dak Bungalow (resthouse) which has lately been erected and is mostly made of teak, with shingle roof, and where only the bare furniture is supplied. You have, of course, brought with you your body servants and your cook (all with innumerable small packages and umbrellas, to which they stick under all possible circumstances), your provisions, and your bedding, and there you make your preparations for conveyance up-country.

The part of the country where tin and wolfram are now being obtained extends from 32 miles south of Tavoy to some 40 miles north, with a maximum width of 28 miles. None of the metals has so far been obtained from the right bank of the river or the promontory, except north of Tavoy. The strip of country has a NW-SE trend, which, as will be shown later, corresponds with the strike of the exposures of intrusive granite. With the exception of the river estuary, the country is very rough, and covered with thick, even impenetrable jungle, abounding with water-courses, leeches, and wild animals (bears, small tigers, and black panthers). There exists practically only one metalled road in the district, that from Tavoy to Miytta, to the east-north-east, near the Siamese border, which is fairly well maintained by the Government, but on which it is at present difficult to travel owing to most of the wooden bridges being in the course of replacement by more permanent steel structures. This road goes through the heart of the mining district. Many bridle and cart tracks have been cut by the miners themselves to reach their concessions, and for the present they seem to meet requirements. Several branch roads are projected and have been promised, but the authorities are still pondering as to the date of their commencement. I believe that the real difficulty is that of obtaining the necessary labour.

Numerous creeks and streams, a few of them running all year, cut the hills and form gullies and small deep valleys in all directions, although the dip of the watershed is toward the southwest and their trend is mostly in that direction. The rainfall during the $3\frac{1}{2}$ months of the monsoon is excessive, approaching in some instances 400 inches, but averaging 240 inches.

During that season, travel is almost an impossibility, every little creek being transformed into a raging torrent. During the remainder of the year there is practically no rainfall, most of the creeks become dry, and thus the miner is deprived of his most essential requirement. During the winter months the temperature is tolerable, and owing to greater dryness of the air, it is much more bearable than similar heat anywhere in the Malay peninsula. At night the temperature often falls below 60° F., and, needless to say, at that time, insect life is inactive. It is, however, only recuperating and gathering energy for the coming hot months when it will come out in its battalions to wage a fierce and one-sided battle against humanity.

The prevailing mode of locomotion is by carts drawn by small Indian cattle, which on a road or fair track can be reckoned to do two miles an hour, provided, of course, they do not



BURMA.

capsize in a creek or butt against a bamboo cluster. An average journey is 12 to 14 miles per day. For parts more remote, elephants must be used, as there is great difficulty in securing native porters of any kind, except for light objects. You must perforce establish your main camps as near as possible to a track, and the rest of your work is done on foot. Ponies and mules can be obtained in some parts, but are not generally favoured, as they require a special staff to keep them from going astray, and forage or rice must be carried for them, otherwise they deteriorate rapidly. This is essentially a country for a good walker.

The mining law, as applying to base metals in Lower Burma, is in the making, and of course, remarkable for its simplicity and its incompleteness. Its present improved form is the result of a dissatisfaction loudly expressed, when every one wanted to secure a concession; and it was, I believe, hurriedly drafted by some Indian government official. It has some good points, but many weak ones, and if it were revised and extended by a practical engineer conversant with mining laws in other parts of the Empire or the world, might become clear, precise, serviceable, and give better security of tenure, qualities that at present it can hardly be said to possess.

If the mining industry is to develop beyond its present achievement, the law will be found inadequate, will give rise to many troubles to all concerned, and will be a deterrent to the introduction of foreign capital. It is called "Rules for the grant by Local Governments of Licences for prospecting for Minerals and of Mining Leases in British India," and it was prescribed by the Governor General in Council, and sanctioned by the Secretary of State for India, in Council, and published in Simla on September 15, 1913.

Its main features are as follows:

Before an application for a prospecting licence or a mining lease can be made, a "certificate of approval" must be obtained at a cost of 50 rupees from the "local government," which is represented either by a revenue officer in charge of a district (who may be a Deputy Commissioner) or a Chief Commissioner. The "local government," in provinces where there is a Board of Revenue or Financial Commissioner, may delegate to such authority all or any of the powers conferred by these rules. A certificate of approval is valid for a period of 12 months, renewable at the discretion of the local government on payment of 50 rupees. The object is obviously to exclude such persons as are not considered fit and proper, or who are not in a financial position to prospect or do mining work. The granting of such certificate may take place many months after application has been made.

Prospecting licences are only granted to those in possession of a "valid" certificate of approval, and confer on the licensee the sole right to mine, quarry, bore, dig, and search for, win, work, and carry away any mineral, etc., specified in the licence.

A licence can only be granted in respect of such land which is Government ground, and is available for 12 months, renewable at the discretion of the local government for further periods not exceeding two more years. A plan must accompany an application for a P.L. and must show as accurately as possible the situation, boundaries, etc. A local government can refuse an application for a P.L. on the ground of "inexpediency," but an appeal can lie from such decision to the next higher revenue authority. The licence is issued in "such form as may be prescribed." An applicant must deposit as security a sum of 100 rupees per square mile applied for, and pay a fee not exceeding one rupee and not less than one anna per acre, and may obtain the licence over a total area of 10 square miles.

Every prospecting licence may contain "such conditions as may in any particular case seem necessary." Licences may be granted over areas extending to 10 square miles and are transferable with the sanction of the local governments.

Mining leases are granted in a way similar to that applying to prospecting licences, for such periods as the licensee may desire, and under such conditions as may be laid down by the local government. The area held by a lessee in any particular district is limited to 10 square miles, and the ground-rents are fixed arbitrarily. Within 12 months of the granting of a lease, work must be undertaken to the satisfaction of the government, and must produce enough metal that the tax thereon of $2\frac{1}{2}\%$ must at least equal the amount of the ground rent.

It will thus be seen that there are several weak and undesirable points in the law. For instance, in the case of P.L., the licensee is allowed to carry away and dispose of all the ore he can get, and being granted some three years to do so, he will naturally work out all the easily obtainable and profitable surface deposits and the outcrops, will undertake no development of any kind, and at the end of his time, will not trouble to take out a mining lease. As will be easily understood, this does not make for the good of the country.

A prospecting licence being transferable at will, many must have been applied for and secured with the only object of disposing of them, if possible, at a high figure, and thus locking-up ground and making a gamble of what should be serious business. There is no fixed legal form for a licence or a lease, the conditions being left entirely to the discretion of the local government, which can make them favourable or otherwise to the grantees, so that in any case one does not know what one is going to get. In matters of renewals, cancellations or disputes, the decision of the local government is final and without appeal, and this may give rise to unfairness and abuse.

The areas granted are altogether too large and unwieldy, and the result is a locking-up of the country. There is nothing of a fixed nature as regards the use of water, disposal of residue in streams, etc., although a foot-note makes known the fact that the local government may make rules from time to time to that effect.

In order to bear out my remarks, it need only be mentioned that since the discovery of wolfram in Lower Burma, only five mining leases have been taken out (four quite recently) and one local company working under prospecting licences has during the last three years paid out in dividends 160% on its called-up capital of 150,000 rupees. I think this instance must be unique in the mining world.

The number of prospecting licences in force at the present time in the district of Tavoy is about 88. The majority of these will be expiring within a short time, and there is reason

to believe that, in most instances, the work accomplished being small or unimportant, the applications for M.L. will be refused by the Government.

The law shows either a want of foresight or else a feeling of doubt as to the future of the industry, and until now there seems to have been a desire to make as much as possible out of the industry in the shape of rent and taxes. There are, however, at the present time, appearances of great changes in that respect, and the local governments are most active in their endeavour to assist the industry, and to insist upon the work being done in a safe and workmanlike fashion, under the direction of competent and responsible men.

Throughout the district there are only a few trigonometrical survey stations, and so far the survey of concessions has mostly been made without reference to them. The Government now realizes the necessity of accurate surveys, and has a large staff in the field; but it is remarkable that most of the detail work is being done by theodolite, and chains, and table plotting on the spot. The chains used are in all sorts of conditions of wear and repair, and measurements are plotted directly without any further reference to the inclination of the lines than an arbitrary allowance for such. No working out of co-ordinates appears to be done at present, as this work is probably reserved for the rainy season, when field-work is practically impossible. In the meantime a general map of the district is being made out of this rough survey, which will prove of some assistance to the concession-hunters, but will not by any means be accurate, and may later, unless replaced by an accurate one, prove a source of trouble to all concerned. The matter is not of great concern at the present moment, as only one mining lease has actually been obtained.

Some concession-holders, in order to protect themselves, are undertaking accurate work by well qualified surveyors, but they cannot make sure that these surveys will be accepted as correct by the Government. Instances have been known of complete disagreement in this matter, where surveys by qualified European surveyors have been questioned and rejected by native or Eurasian surveyors whose knowledge of trigonometrical calculations is of the most elementary kind, and whose instruments, and chains especially, are not distinguished by their accuracy. The absence of, or inaccuracy of, surveys when prospecting licences were granted, has given rise to some prolonged disputes, but all these have now been duly and satisfactorily adjusted by the local government.

The main geologic features of the district are extremely simple, and consist of two types of rock: schist and granite. They occur in massive and sometimes rugged outcrops mostly covered with a small thickness of soil and thick growth of jungle. In nearly all watercourses the rocks are exposed bare, and these are so numerous as to offer many opportunities for examination.

For want of a better denomination the schists are called the Mergui series on account of their having first been discovered in that district, and traced northward. They consist of a series of rocks ranging from hard slate to quartzite, apparently showing true bedding, having a general strike NW-SE and a steep dip to NE. Whether the bedding-planes represent the original planes of the stratified rocks from which they have been derived, or whether they are only pressure-planes resultant from the upheaval of the granite, is not yet certain. The latter may eventually prove correct, inasmuch as there are also some subsidiary partings that may mark the original bedding, and the strike of the main bedding follows a line parallel to the granite intrusions, and only alters slightly with the contour of the contact. The schists in places give way to sandstone and quartzite, but without any district demarcation, and they gradually merge into one another. The strike and dip of the quartzites are practically the same as those of the schists, but so far no characteristic or continuous bed having been traced for any distance, and their occurrence being practically lenticular, it is possible that they are only schist locally altered by movements and infiltration.

The granite is generally a holocrystalline biotitic rock, becoming porphyritic near its contact with the schist. Cassiterite as a constituent has only been noted in the porphyritic portions.

The main outcrops of granite follow as near as possible the general strike of the schist, as shown by the map on the preceding page; when starting from Wagon they are successively noted at Bolin Taung, Kalonta, Kyank Chaung, Pa Chaung, and Sebalon Chaung. The actual contact with the schist is rarely exposed, but where observed by me, the granite gradually merges from porphyritic granite to a broad band of highly ferruginous felspathic rock, which itself gradually merges into highly fissured schist. It is interesting to note that this ferruginous band shows an appreciable quantity of cassiterite.

The nearest granite west of the line described occurs in the southern portion of the Tavoy promontory. Farther east the schist gradually disappears and gives way to a wide range of granite, which undoubtedly continues south to Singapore, forming the backbone of the Malay Peninsula. This portion of the country, apart from its upheaval by the granitic intrusions, appears to have been remarkably free from other disturbances. If uncomformities and faults exist, they have not yet been discovered, and there are no signs of basaltic or dioritic intrusions of any kind.

The schist, within a belt not exceeding 12 miles wide from the edge of the granite intrusion, contains many mineralized zones of considerable thickness and lateral extent, with their main axes corresponding to the strike of the enclosing rock. They are practically lenticular in shape, petering out gradually at each end into hard unmineralized schist. They do not follow any particular main break in the country, but keep remarkably parallel to one another, and to the line of the intrusive granite. These zones show that the schist has been much decomposed and altered, and they contain numerous quartz leaders and veins all running parallel to the bedding of the schist. These form the main source of wolframite.

Some veins are also found running at right angles to the general strike. They occur mostly in close proximity to the granite, and, as far as has been ascertained, they are of more recent origin than the former, and have been formed by later movements of the granite and subsequent infiltrations. Taken all through, these later veins are generally of greater and more even thickness ; and, where metal-bearing, the contents are more consistently distributed than in the schist veins.

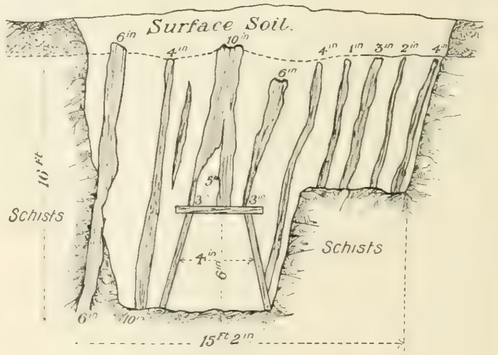
In all the mineralized zones, a good deal of mica is generally found on both walls of the quartz veins, and in parallel stringers through the schist. The schist in these zones shows slickensides, and in places carries wolframite as an impregnation without the presence of quartz. The zones vary greatly in thickness, as well as in the number and size of the quartz veins they contain. The section here given shows an open quarry where the proportion of quartz per foot of width is 1 : 4 over a width of 15 feet. On the same zone is an open quarry that for a width of 67 ft. gives a proportion of 1 : 6·5. Other results in adits in the oxidized zone have given : for 135 ft., a proportion of 1 : 21 ; for 96 ft., 1 : 20 ; for 152 ft., 1 : 20 ; and for 135 ft., 1 : 27. As against this, however, some zones are found to carry one or two veins only, but those are of a thickness up to 5 ft. When the veins are few and of great width, quartzitic schist is generally in close proximity.

In the case of veins or cross-veins adjacent to, or cutting through, quartzitic schist, cassiterite has generally been found associated with the wolframite, or as an impregnation in quartzite.

Some suggestions have been made as regards classifying the different veins into three categories, namely, wolframite veins, wolframite and cassiterite veins, and cassiterite veins. The distinction, however, cannot hold, as the two minerals are found mingled in the same zones, although in disproportionate quantities. Some veins found to contain wolframite only change their nature to wolframite and cassiterite, or else to cassiterite only. The few veins in which cassiterite alone has been found, are generally close to the granite, or else cutting into the latter. Evidently, the mineral solutions that formed the veins carried both wolframite and tin. The latter, owing to its less solubility, was probably deposited much sooner than the former and therefore at a greater depth. Unfortunately, no work has been done in the pyritic zone. In only two instances has the fringe of that zone been reached. The rock became hard and required blasting, and the wolframite contents decreased so rapidly as to render the work unprofitable. The exploring of the pyritic zone is therefore carefully being avoided by all, and the work is being done above it, where the rock is soft and the mineral contents are generous. This is much to be regretted, as it has an important bearing upon the future of the mining industry. As will be shown, the mines are worked superficially, the feeling being that in depth the contents in wolframite will become gradually less and will eventually disappear. This feeling, in my opinion, is quite justified and would appear to correspond to general experience in similar deposits, but the complete disappearance of wolframite as soon as the pyritic zone is reached is not a foregone conclusion. Wolframite may continue for some depth, but it is almost certain that it will gradually give way to cassiterite. Whether cassiterite will then be in quantity sufficient to make its extraction profitable, remains to be seen ; and it is a great pity that some of the working companies, now making a handsome profit out of surface working, do not devote a little of that profit to systematic exploration in depth. Until this is undertaken, thoroughly, the life of this mining district is limited to a few years. Exploration in depth has now become an absolute necessity, and if it is neglected until the surface ore has been stripped, and the profits have been distributed up to the hilt, the industry will come to a stand-still. It is therefore 'up to' these companies that are making profits to undertake such work. In this respect, it is thought that the Government, which is getting such a good income from the industry, should assist the companies on the £ for £ principle, for deep exploration. This is not asking much from the Government, which apparently is doing little for the industry and excuses the idea that it has no faith in its future. If such work could be undertaken, I feel sure that its cost would prove to have been amply justified. The great difficulty of the Burmese government, however, seems to be that the large sum paid yearly to the Indian government absorbs the whole revenue, so that practically nothing is left, or obtained for the development of the country. What small amounts may be granted to the Burmese government is promptly absorbed by the town of Rangoon, and no thought is being given to the possibilities of such an outlandish country as Tavoy.

The wolframite is generally found in the veins in sporadic bunches of massive ore. In some cases the ore is more finely divided in the shape of small crystals and needles. Fine-grained wolfram is not seen, although it is often represented by a peppering of iron oxides resulting from its decomposition. Long stretches of barren quartz are often found between two bunches, but these vary in every vein. The mica (muscovite), which is generally found on the walls of the veins, sometimes encloses small crystals of wolframite. A little tourmaline is present in the quartz, and it is more prominent near cassiterite. No fluorspar has been observed, but occasionally a small quantity of chalcopyrite and molybdenite is found when approaching the pyritic zone. The cassiterite is generally seen in coarse crystals adhering to one wall only of the quartz veins. When found in conjunction with wolframite, each appears to stick to its particular wall, and seldom do they happen to meet. In the upper parts of the veins, geodes or cavities lined with crystals of quartz and a little iron oxide are frequent. These must have been filled originally with wolframite, which gradually dissolved away, leaving only the iron oxide as evidence of it having been there. Some lithia chlorite is reported to have been found in veins, and occurrences of tungstite (yellow ochre of tungsten) are common near the surface.

The outcrops are covered over by thick jungle and a varying thickness of overburden, except on the sides of the gullies and creeks, where they are exposed by denudation. It is from these points that work is started. These exposures are, however, not necessarily the most valuable portions of the zones, and as no systematic prospecting is done, it is probable that much mineral remains undiscovered. The exposed outcrop of a zone that does not at once produce enough wolfram to pay expenses is generally abandoned without any attempt being made to trace it either way by means of surface trenches, shallow pits, or adits from some convenient point. The only prospecting that appears to be done is to allow a few Burmans to fossick in an attempt to trace the

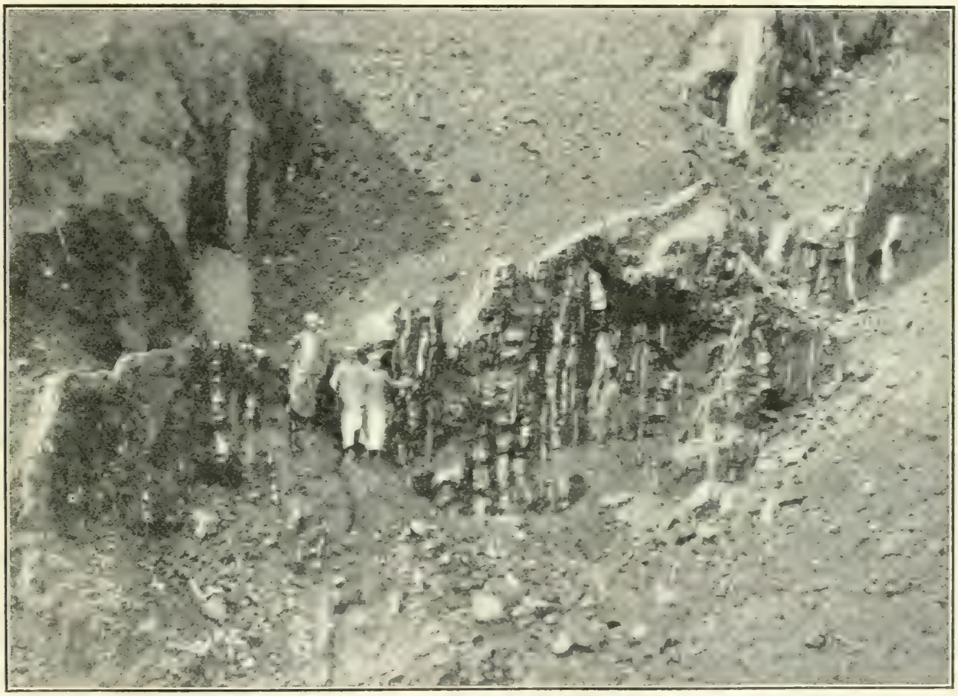


Section across Wolframite Workings.

wolfram. At this work the Burman is very clever, and within a few days he may bring in a bag or two of ore. The Burman is keenly watched by the Chinese, and if he should happen to strike a promising spot, he finds on going there the next morning that a gang of Chinese coolies is hard at work on his pitch. Hence a complaint to the one who happens to be in charge of the work, unless the Burman has been 'squared' by the Chinaman, and has moved his pick to some other spot. Wolfram having thus been struck, the Chinaman is generally allowed to work on it, at his own sweet will, provided he hands over all the wolfram obtained, for which he is paid at a fixed rate per ton. His work may be of any kind, with the usual result that when he works open-cut, he generally takes no precaution for the prevention of accidents, and creates real death-traps. If he decides to start an adit, he makes it of such dimensions as will best suit him, and if he at all timbers any weak spot, he generally does so in a cheap and inadequate fashion. He will not undertake to do a specified kind of work unless he gets paid footage in addition to being paid for the ore. In most cases, therefore, he is allowed to work as he likes. When he comes to some poor or unprofitable portion, he moves his chattels to some other spot, and the chance of proving the value of that vein is lost. If he gets on to ground that cannot be brought down by the pick, he immediately abandons the work. The organized companies attempt to regulate the nature and quantity of work to be done, and give out contracts, but cannot make sure that the work will be carried out, for, if the Chinaman thinks he is not making enough money, he abandons it. There seems to be no redress against the worker breaking his contract, but the companies arrange for the payment of a month's work to be made on about the 15th of the following month, thus having about a fortnight's work in hand as a security, the value of which is forfeited to them if the worker departs.

The Burman will often accept similar work at the same price, but being an inferior worker to the Chinaman, makes less money, and he will only stick to the best portions. He is, however, a most erratic and easy going worker, and will often leave his job, to roam further afield, or to go and attend to his paddi-field, without warning and without claiming what is due to him. It can be said, therefore, that practically no prospecting is done with a view to tracing the mineralized zones under the surface drift.

The sand and clayey sand that are immediately above the outcrops, and for some distance along the lower slope or talus of the hills, carry small quantities of wolfram, varying from $\frac{1}{4}$ to 5 lb. per cubic yard. These sands are locally called 'alluvial deposits.' The designation is a misnomer, as the deposits have none of the characteristics of an alluvium, nor is it possible to conceive wolframite, which is so easily disintegrated and so easily decomposed, to form any approach to an alluvium. If the designation of 'wolfram drift' or 'talus deposit' is suggested, it is considered derogatory, and a reflection on its potentialities! These drift deposits are extensively worked in a haphazard way during the wet season, but no attempt is made to trace their extent or exact contents. The result generally is that when a patch begins to



Native Open-cut Working on Wolframite Veins.

show a decline in yield, it is abandoned, and another rich patch is sought.

As no systematic development has been undertaken, it follows that no real mining has been accomplished. With the exception of perhaps one property, where primitive development has been attempted, the work is really only 'fossicking.' On a wide zone, with veins close together, a few adits may be put across the formations and only in the oxidized portion; for as soon as the work gets a little hard, or the pyritic zone is approached, operations are abandoned. In the course of this crosscutting the different quartz stringers are encountered, and any wolfram obtained is sorted out and placed in bags. If a rich leader is cut, a little driving in both directions may be undertaken; but this will be stopped as soon as the pocket of ore is exhausted. Another adit will then be commenced 'on spec' a few feet to the right or to the left and generally a few feet above, care being exercised to hug closely any rich spot that may have been found, and the same work proceeds. The result is the crowding of small adits within a restricted area. If it is possible to attack the zone endon by adits, those leaders that are most promising are followed, the wolframite is obtained, and perhaps one or two cross-cuts will be driven. If the yield from the leaders is erratic, the work soon stops; but in any case it is invariably stopped when blasting ground is encountered. It may be said, therefore, that the work consists only in discovering the rich pockets and extracting the ore over the size of the level or cross-cut, that is, "picking out the eyes." Generally, no rising or sinking on any pocket is undertaken. In the exception mentioned, the quartz veins strike at right angles to the foliation; they are of a good average thickness, from 12 to 30 inches, and the wolframite contents as far as have been proved are more evenly distributed than usual. The veins are here conveniently attacked endon by adits. An attempt was made to trace these at vertical heights above one another of 60 ft., connecting with rises, and then opening by overhand stoping. This class of work, however, was not congenial to the Chinese miner, who was eventually and perforce allowed to mine according to his own ideas. A series of adits are therefore driven more or less simultaneously, at a vertical height from floor to floor of about 12 ft. These adits are generally 4 ft. wide and 6 ft. high, so that 6 ft. of vein-matter is left between the roof of an adit and the floor of the one above. All quartz showing a goodly proportion of wolframite is sorted out and placed in bags, but the poorer stuff is thrown on the dump. Thus large quantities of quartz carrying from ½ to 1% of wolframite can be picked up. When the adits have reached hard country, or a poor patch, small openings are made at irregular intervals between, and from these the work of extracting the quartz extends longitudinally. The quartz only is extracted clean from above and below, and no portion of either wall is touched. In some places these small stopes have only a width of 10 inches, and it is wonderful how the miner manages to do the work in such a restricted space. The only pillars left are occasional blocks of quartz considered too poor to be touched.

In this class of work the Chinese get paid footage for the levels at the rate of about R. 1 to 1·4, and receive R. 250 per ton of wolframite produced. It is stated that the cost of this method does not exceed that of stoping with 60-ft. stopes. This kind of work in some instances is copied by the Burmese miner, who, however, seldom undertakes the driving of more than two adits at a time, placing them about 20 ft. apart vertically, and stoping between them with a width equal to that of the levels. In those places where adits 60 ft. apart had already been connected with rises with a view to stoping, and where the work had been stopped, the Chinese miner started, from the rise, a series of small levels each way, at heights from one another of about 10 to 11 ft. These small levels seldom exceed 2 ft. 6 in. in width by 5 ft. 6 in. in height. The quartz carrying wolfram is bagged as found, and the waste is shot down the winze, which acts as a collecting chute for all the little levels. When the stope-levels have gone a few feet, generally half the distance between two rises and winzes, the ore remaining between them is taken out, with the production of as little waste as possible. Owing to the narrowness of the levels and the natural reluctance on the part of the miner to shovel or to carry the waste in buckets, they seldom attain a length exceeding 25 ft., and if the rises provided are more than 50 ft. apart, it is probable that a portion of the vein between will be left. All this work, being in the soft and oxidized zone, is only undertaken during the dry season. When the rain comes the stopes collapse entirely, or are filled in the sand washed from above, but the former case is the more usual. On resumption, after the rains, work is either started farther up or lower down the hill, and the previous levels are not picked up again. As far as is evidenced anywhere, the fringe of the pyritic zone is reached at a vertical depth of some 100 ft. The length of the levels therefore is dependent upon the slope of the hill. The class just described represents the best mining in the district.

The drift deposits are worked when water is abundant during the rainy season, or where a small pumping-plant has been provided. The water is conducted into some natural channel with hard bottom on the slope of the hill, and the immediately adjoining drift is excavated by pick and shovel, conveyed in baskets, and dumped into the natural ground-sluices. The concentration is left usually to look after itself, but is sometimes assisted by raking the stuff down-stream. After a few hours work, the bottom of the sluice is raked out and concentrated by hand in a rocker or dolly, similar to those used by gold-streamers. Sometimes a wooden sluice is provided, and occasionally a hand-worked trommel is used to separate the boulders. A diamond-washing pan has also been noted, and is reported to give a much better concentration than the wooden sluices. This is an interesting fact, as it recalls the experiments with such pans, carried out by me some years ago on the Kuils River tinfield, with results that were published in the Transactions of the Chemical & Metallurgical Society of South Africa.

Up to the present, drift deposits have been entirely worked by hand, but at least two plants are now being erected with a view to the use of monitors.

It is extremely difficult to ascertain the contents of these deposits without a good deal of pitting, and the results now being obtained vary enormously according to the local circumstances. It is, however, reckoned that the returns must be at least 3 lb. of wolfram per man per day for any gang of workers to undertake the work, and as a gang usually does not exceed a cubic yard per man, it follows that the contents of the drift must be at least 3 lb. As may be imagined, the work is crude and the loss is great. I have obtained 2 to 3 lb. per cu. yd. from the sand rejected from the sluices, after similar quantities had been obtained in the sluices. The work of the Chinese sluicer is much inferior to that done in the Malay States. He has no idea whatever of what concentration should be, and fine wolfram even in important quantities is below his notice, as involving too great an exertion to recover.

In the case of one property having in the rainy months an ample supply of water and a good fall, and where three monitors will shortly be at work, it is calculated that a return of ½ lb. per cubic yard will yield a profit.

The wolfram ore is crushed entirely by hand-hammers over flat stones. I believe that there is not a single pestle and mortar, or even a Chinese foot-stamp (except for crushing rice) in the mining district. The prevailing idea seems to be that, owing to the brittleness of wolframite, crushing in a mortar would produce too much fine, which would only be recovered after more exertion than the worker is prepared to expend. The rejected small stuff from the hand-crushing is invariably rich, and would pay handsomely for crushing and concentrating by machinery. The work therefore is extremely wasteful. The hand-crushed stuff is washed in a rocker or cradle to a concentrate of about 68 units (68% WO_3), and most of the fine is allowed to go to waste.

In the case of the drift wolfram, no crushing is necessary except in the case of lumps picked from the sluices, and concentration is done as described above.

It is seldom that impurities occur in sufficient quantities to vitiate the value of the concentrate. These impurities consist generally of pyrite, iron oxide, molybdenite, and cassiterite. The latter was for some time considered an impurity to be thrown away if possible, as the worker only got paid on the assay-value of wolfram, and the greater the percentage of it, the less he got for the latter. Nowadays, however, when cassiterite is present in the concentrate, it is sold at the same rate as the wolframite.

No attempt is being made to separate the cassiterite from the wolfram, and the two are generally bought by the ore-buyers in such a way that cassiterite is only valued at the same rate as wolframite. The ore is dried before being packed in single strong gunney-bags and almost exclusively exported to Germany. The leading companies sell their ore on contract direct to German firms, but the small miner sells to local ore-buyers, of whom there are several in the district.

The following rates for contract work prevail in the district: For quarry or open-cut work the coolies receive from R. 45. to 500 per long ton, less deductions for moisture and for ore of a lower quality than 68%. In the case of drifting and cross-cutting the footage is paid at rates varying from R. 1 to 2½ for drifts 6 by 4 ft., and the wolfram obtained and dressed up to 68% is paid for at the rate of R. 250 per ton. The latter class of work is much favoured by the miner, who can always make his wages out of the footage alone.

In the case of a large number of properties, where there is no supervising staff and no general expenses, the owner can generally make sure of a net profit of some R. 1000 per ton produced. In the case of organized companies, the cost of production varies from £50 to £80 per ton, according to circumstances.

As the price of wolfram has varied little of late, the local standard assumed is R. 1500 per ton, which represents as near as possible the value of 68% ore at 33s. per unit (£112. 4s. 0d.) after export duty, freight, etc., have been deducted.

The labour consists of Chinese, Burmese, and several classes of Indians, including southern Indians or Tamils, a few Goorkas, etc.; the Chinese, however, largely predominate.

No restriction is placed on the immigration of aliens, who are only required to pay a poll-tax of R. 2 per annum. As no registration of any kind exists, the aliens generally manage to escape payment of the tax, and they roam at will all over the district, unbound in any shape or form, and free from any kind of responsibility. The Chinaman carries with him his old established customs, and guild organization, and is at any time capable of dictating terms to his employers. As the latter are hardly organized yet, they are entirely at the mercy of the miner. It is hoped, however, that through the formation of the Tavoy Chamber of Mines, such a state of things will soon cease to exist, and that in due course the exorbitant rates of pay now prevailing will be brought down to a more reasonable figure. The Chinese coolie shows no disposition to work unless he can make sure of R. 2 per day, and when it is considered that he can live extremely well on from 6 to 8 annas per day (6d. to 8d.), the rates appear much higher than those prevailing in adjoining countries.

The Chinese in Lower Burma are indifferent workers with little idea of systematic or economical work, and show no disposition to learn or to improve their methods of concentration. In that respect, they are very different from their compatriots in the Federated Malay States. They are not yet in sufficiently large numbers in the district to create competition, and naturally do not look favourably upon new-comers, nor do they advise their relations or friends in other parts to come to Burma. The Chinese are occasionally employed on day's pay at the rate of R. 1·4 to 1·10, but at this they are difficult to secure or to keep.

The Burman, as far as mining work is concerned, is unsatisfactory. He has no idea whatever of how to use a pick or a shovel, nor will he ever be taught. He cannot work steadily for any length of time, and he clears out when he feels inclined, hard physical work being entirely against his notions.

The Tamils, although not physically strong, generally work steadily and do not care to roam about. They settle on a property with their families, all the grown-up members of which work and assist in general comfort and welfare. They are generally employed on surface work only, on day's pay at 12 to 14 annas, and occasionally on contract work.

The artisans are mostly Chinese, and the following rates of pay prevail: Carpenters, R. 2 per day; fitters and blacksmiths, R. 40 to 50 per month; engine-drivers and boiler men, R. 40 to 50.

The labour question, unless it be promptly and efficiently tackled by the Chamber of Mines, will soon become acute, and the cost of the work will increase considerably. Some of the leading companies are likely to consider the advisability of importing their own labour under the indenture system. Although this would be a new departure as far as Burma is concerned, there is reason to believe that, under certain guarantees, the Government would give its approval and support.

I am informed that a large amount of ore is stolen, but that it is difficult to track the offenders. The fact that a miner may obtain from R. 800 to 1000 per ton from tin-buyers, whereas he does not get more than R. 500 from his employer, would naturally seem to be a great inducement to deal with the ore-buyers rather than hand the ore to the owner. That this kind of thing is prevalent is not to be doubted. On several occasions, offenders have been caught red-handed and brought before the magistrates. The latter passed only mild punishments, based upon the value of the ore, and altogether out of proportion to the seriousness of the offence. The punishment is so inadequate as to be no deterrent. The ore-buyers do not require a licence, nor is their business controlled or checked by the Government in any shape or form. They are not compelled to inquire into the origin of the ore offered for sale. Under these circumstances, the thief is perfectly safe, and thefts are bound to continue. The Government would do no harm in copying the Federated Malay States practice in that respect.

The principal companies operating in the district were floated in Rangoon with local capital, and are controlled by two main groups namely, the Radcliff group and the Tavoy Concessions group. The Radcliffe group includes the Rangoon, Egane, Burma Malaya, and the Radcliff companies, particulars of which are given in the following paragraphs.

The Rangoon Mining Company was floated in 1909, with an authorized capital R. 260,000. The property is situated at Pagaye, 10 miles northwest of Tavoy, and covers 2915 acres. Two mineralized zones run parallel to one another and 70 to 80 ft. apart in a northwest direction. The eastern zone has a maximum width of 300 ft., and the western zone a maximum width 60 ft. The quartz veins are small but numerous. In lateral extent the zones have so far been proved for 1000 yards, and are likely to extend for a further distance. The following table gives a summary of results:

	Years Ended			
	Aug. 31, 1910	Aug. 31, 1911	Aug. 31, 1912	Aug. 31, 1913
Tons produced ...	105½	324	277	151½
Realized per ton...	£117 0 0	£111 0 0	£100 0 0	
Mine cost ,, ...	£78 10 0	£54 8 0	£66 13 4	
Total cost ,, ...	£91 6 2	£70 9 4	£81 10 8	
Net profit ,, ...	£25 13 10	£41 10 8	£18 19 4	
Dividends............	R. 40,000	R. 130,000	R. 90,000	
Balance carried forward............	R. 1,000	R. 74,657	R. 82,432	

Average assay-value of the product is 68% WO_3, and the average percentage of cassiterite in the concentrate 4%. The loss of weight in shipping to Hamburg is 1%. The labour force at present employed numbers 300.

The plant consists of ore-breakers, rolls, shaking-screens, jigs, and two Wilfley tables. The capacity is 120 tons per 24 hours.

One suction-dredge with sand and water pump, to work three monitors, will start shortly.

In addition to the property at Pagaye, this company holds also under prospecting licence the Talaingya property, 5 square miles in area, and the Ohnbinkwin East, of 4½ square miles. On the latter, which adjoins the well known Kambauk mine, some alluvial tin has been found.

The Egane (Tavoy) Mining Company has been worked since October 1910. The capital is R. 50,000. The labour force during 1911 was 80; for 1912, 84; and for 1913, 68. The output of concentrate has been as follows:

	Tons
October 1910 to June 1911.........	13¾
June 1911 to June 1912..............	14¾
June 1912 to June 1913..............	12
June 1913 to January 1914.........	14

Radcliff & Company was floated privately in December 1910, and as a public company on January 1, 1913. The capital is R. 1,35,000. The area of the Manbank Taung property is 7½ square miles. Labour force during 1911 was 56; for 1912, 250; and for 1913, 290.

The production has been as follows:

	Tons
1911	77¾
1912	206¾
1913	255½

A 10-stamp mill has just been erected. A scheme for working certain tin deposits and drift wolfram will be inaugurated when the rains come. The output of this company is likely to increase considerably.

The Burma Malaya Mines Company has a capital of R. 9,97,500 and owns a number of properties. The Ohnbinkwin West covers 2400 acres. Boring over 500 acres gave an average of ½ lb. cassiterite per cubic yard. The property 'Booth's Grant' covers 750 acres, and has been partly worked for alluvial tin with returns of 1 lb. cassiterite per cubic yard. At the 'Wagon' property of 2721 acres, work started December 1913–January 1914. The 'Malonta,' covering 2772 acres, contains promising drift deposits, but work has not yet been started. The 'Boulandaung,' of 2616 acres, produced during 1911 16 tons; 1912, 6¾ tons; and 1913, 5½ tons.

The Tavoy group comprises the following companies: Tavoy Concessions, Tenasserim Concessions, and the Hermyingyi Mining Company. The total capital is R. 12,00,000. The area covered is 23 square miles. Seven properties are producing, and the labour force is 500. The output was as follows:

	Tons
1911	275
1912	365
1913	425
January 1914...........	55

The Output of Minerals in the United Kingdom during 1913 is provisionally returned as follows, the figures for 1912 being appended for comparison:

	1913. Tons.	1912. Tons.
Coal........................	287,411,869	260,398,578
Oil Shale....	3,280,143	3,184,826
Iron Ore.....................	9,591,477	8,420,126
Iron Pyrite......................	11,427	10,522
Copper Concentrate..........	2,705	1,912
Gold "Ore"........................	4	170
Lead Concentrate............	24,265	25,383
Manganese	5,393	4,170
Tin Concentrate	6,942	6,822
Uranium Concentrate	95	42
Wolfram Concentrate	182	189
Zinc Concentrate............	17,294	17,704
Arsenic	1,694	2,193
Arsenical Pyrite	35	1,778
Barite..........................	48,018	42,767
Bauxite..........................	6,055	5,790
Gypsum	238,494	243,811
Limestone	363,841	355,569

QUOTATIONS

of leading mining shares on the London Market.
Shares are £1 par value except where otherwise noted.
Quotations are given in shillings.

GOLD, SILVER, DIAMONDS:	June 1 1913	May 1 1914	June 1 1914
Rand:			
Bantjes	22	14	13
Brakpan	80	45	42
Central Mining (£12)	200	178	156
Cinderella	8	6	6
City & Suburban (£4)	50	48	48
City Deep	62	65	66
Consolidated Gold Fields	52	46	42
Consolidated Langlaagte	27	32	33
Consolidated Main Reef	19	17	17
Crown Mines (10s.)	145	122	117
Durban Roodepoort	29	21	21
D. Roodepoort Deep	22	16	16
East Rand Proprietary	52	35	32
Ferreira Deep	61	50	46
Geduld	24	23	23
Geldenhuis Deep	33	23	25
Heriot	72	60	60
Jupiter	10	5	4
Kleinfontein	22	23	22
Knight Central	12	9	7
Knight's Deep	45	35	31
Langlaagte Estates	25	18	18
Luipaard's Vlei	9	10	9
Main Reef West	11	7	6
Meyer & Charlton	110	108	115
Modderfontein B	77	82	84
Modderfontein, New (£4)	262	248	253
Nourse	37	30	27
Primrose	32	22	22
Rand Mines (5s.)	134	120	118
Randfontein Central	26	20	18
Robinson (£5)	65	55	55
Robinson Deep	37	28	27
Rose Deep	61	43	42
Simmer & Jack	14	10	10
Simmer Deep	4	2	1
Springs	19	13	11
Van Ryn	77	66	67
Van Ryn Deep	31	46	45
Village Deep	41	38	37
Village Main Reef	41	35	36
Witwatersrand (Knight's)	72	70	68
Witwatersrand Deep	61	53	52
Wolhuter	17	16	15
Rhodesia:			
Cam & Motor	31	25	19
Chartered	21	18	17
Eileen Alannah	12	11	10
Eldorado	16	17	18
Enterprise	12	11	8
Falcon	17	13	11
Giant	19	14	13
Globe & Phœnix (5s.)	27	34	32
Lonely Reef	57	31	26
Shamva	55	42	43
Wanderer (5s.)	2	3	2
Willoughby's (10s.)	10	8	7
Others in South Africa:			
De Beers (£2 10s.)	430	335	332
Glynn's Lydenburg	17	10	11
Jagersfontein	140	85	81
Premier Diamond (2s. 6d.)	257	157	160
Sheba (5s.)	5	5	5
Transvaal Gold Mining Estates	52	41	38
West Africa:			
Abbontiakoon (10s.)	7	6	7
Abosso	17	16	13
Ashanti (4s.)	20	15	16
Broomassie (10s.)	7	4	2
Prestea Block A	13	12	13
Taquah	17	15	15
West Australia:			
Associated Gold Mines	7	7	7
Associated Northern Blocks	19	7	7
Bullfinch	16	7	7
Golden Horse-Shoe (£5)	58	46	45
Great Boulder Proprietary (2s.)	14	14	14
Great Boulder Perseverance	2	2	2
Great Fingall	9	8	9
Ivanhoe (£5)	61	52	52
Kalgurli	43	35	37
Sons of Gwalia	22	25	25
Yuanmi	10	4	3

	June 1 1913	May 1 1914	June 1 1914
Others in Australasia:			
Blackwater	21	17	16
Consolidated Gold Fields of N.Z.	12	15	13
Mount Boppy	15	12	13
Mount Morgan	67	52	50
Progress	7	13	11
Talisman	38	37	37
Tasmania Gold (10s.)	1	½	½
Waihi	36	43	45
Waihi Grand Junction	17	27	25
America:			
Alaska Treadwell (£5)	172	162	156
Buena Tierra	20	15	15
Butters Salvador	50	22	20
Camp Bird	18	11	10
Casey Cobalt	52	17	13
Cobalt Town Site	68	42	33
El Oro	14	12	12
Esperanza	18	16	17
Granville	11	10	10
Mexico Mines of El Oro	115	87	95
Oroville Dredging	6	11	11
St. John del Rey	16	16	16
Santa Gertrudis	25	13	12
Stratton's Independence (2s. 6d.)	2	½	½
Tomboy	27	21	21
Russia:			
Lena Goldfields	6	40	33
Orsk Priority	15	7	8
Siberian Proprietary	7	3	4
India:			
Champion Reef (2s. 6d.)	10	10	11
Mysore (10s.)	103	92	96
Nundydroog (10s.)	24	25	26
Ooregum (10s.)	19	22	23
COPPER:			
Anaconda (£5)	151	135	131
Arizona (5s.)	38	38	36
Cape Copper (£2)	125	67	57
Chillagoe (10s.)	½	½	1
Cordoba (5s.)	7	6	7
Great Cobar (£5)	42	3	3
Great Fitzroy (5s.)	1	1	1
Hampden Cloncurry	44	30	27
Kyshtim	65	60	56
Messina (5s.)	28	31	22
Mount Elliott (£5)	102	66	53
Mount Lyell	23	25	25
Rio Tinto (£5)	1527	1432	1387
Sissert	25	28	25
South American Copper (2s.)	36	32	26
Spassky	72	56	52
Tanalyk	52	80	72
Tanganyika	45	39	36
Tharsis (£2)	145	140	127
Whim Well	18	5	5
LEAD-ZINC:			
Broken Hill:			
Amalgamated Zinc	32	29	28
British Broken Hill	44	40	38
Broken Hill Proprietary (8s.)	37	39	37
Broken Hill Block 10 (£10)	31	35	34
Broken Hill Block 14 (25s.)	7	7	7
Broken Hill North	49	54	54
Broken Hill South	158	175	177
Sulphide Corporation (15s.)	27	25	26
Zinc Corporation (10s.)	19	20	21
Russia:			
Russian Mining	10	43	35
Russo-Asiatic	—	186	152
TIN:			
Nigeria:			
Abu (5s.)	14	6	5
Bisichi	22	14	11
Jos (5s.)	8	6	5
Kaduna (5s.)	26	17	17
Naraguta	40	28	25
Nigerian Tin	30	15	13
N. Nigeria Bauchi (10s.)	6	4	4
Rayfield	23	9	7
Ropp	155	120	117
Other Countries:			
Aramayo Francke	35	35	33
Briseis	10	6	4
Cornwall Tailings	27	20	17
Dolcoath	19	11	12
Geevor (10s.)	20	7	7
Gopeng	35	30	32
Mawchi	25	25	23
Pahang Consolidated (5s.)	11	9	9
Renong Dredging	—	52	52
Tekka	67	57	57
Tronoh	75	32	30

PRECIS OF TECHNOLOGY

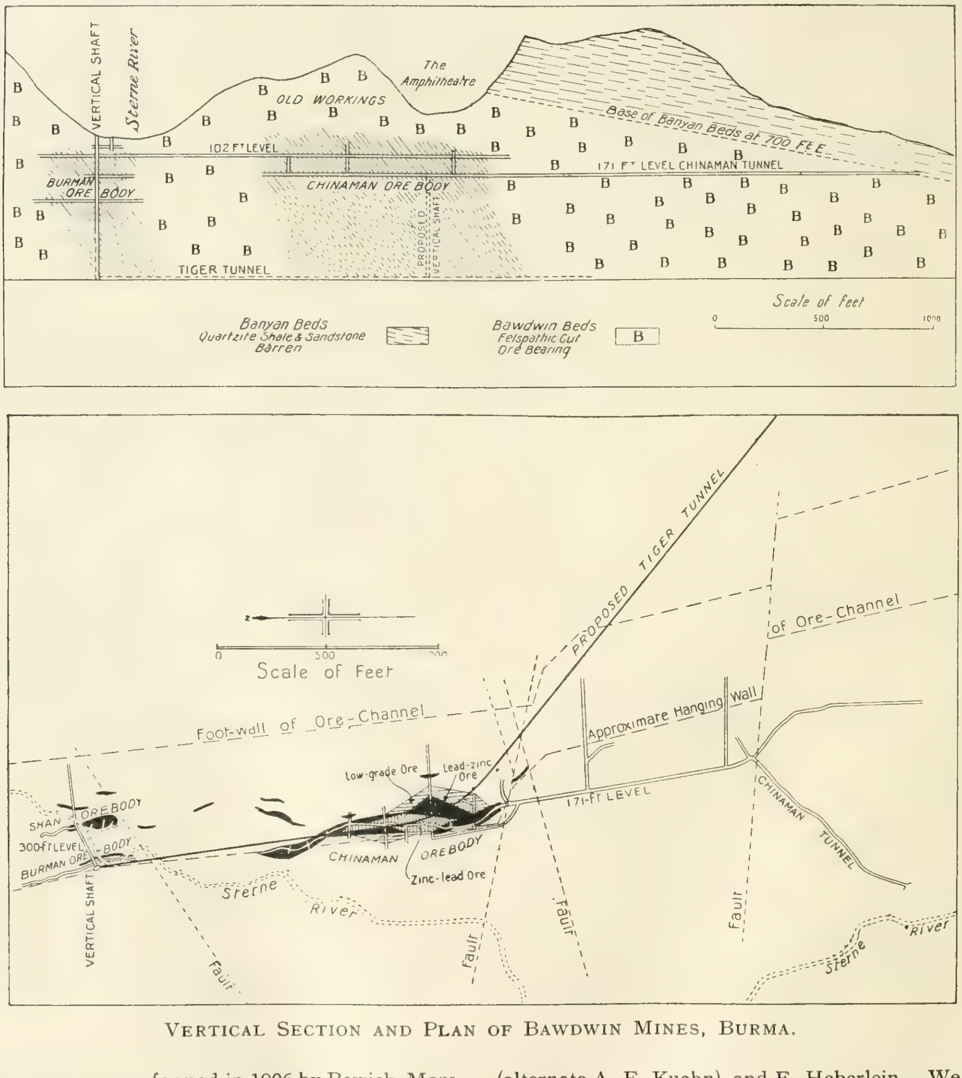
Chuquicamata Leaching Process.—The *Mining and Scientific Press* for May 2 quotes in full a paper by E. A. Cappelen Smith, describing the evolution of the method of treatment adopted for beneficiating the Chuquicamata copper ore. As we have mentioned on several occasions, this deposit is in Chile, 82 miles from the coast, 165 miles from Antofagasta, and 9500 ft. above the sea. The deposit consists chiefly of brochantite, the oxy-sulphate of copper, together with some chalcanthite and atacamite, while sulphides make their appearance in depth. Tho proved reserve contains 200,000,000 tons averaging 2% copper. The control is with M. Guggenheim's Sons, and Frederick Hellmann is manager. The method of treatment has been carefully studied at New York. It was found (1) that the copper mineral was readily soluble in a cold dilute solution of sulphuric acid, and that comparatively coarse crushing was sufficient. (2) That the ore itself yielded more than sufficient acid from the decomposition of the copper sulphate present in the brochantite to make up the losses in acid ; the losses being due to the dissolution of other minerals in the ore and to the waste of solution in the tailing. (3) That no deleterious impurities accumulated in the solution, with the exception of chlorine from the sodium chloride found in association with the mineral in the upper 100 ft. of the orebody. (4) That electrolytic copper of the highest grade could be produced from the acid solution obtained.

The chief substances other than sulphuric acid accumulating in the solution are iron, alumina, nitric acid, and alkali salts. These do not have any deleterious effect on the dissolving and precipitation processes. It is necessary to dilute the solution at regular intervals so as to counteract the accumulation of sulphuric acid. As regards the removal of the chlorine, it was at first thought that it could be removed during electrolysis by having a slight vacuum over the solution and withdrawing it by fans, but it was found that only a part of the chlorine was dissociated and that cuprous chloride was deposited on the cathodes. Subsequently the method was adopted of passing the solution through copper shot placed in revolving drums. The chlorine forms cuprous chloride which is rubbed off by the contact of the rolling shot, the shot by the same action being kept continuously bright. The cuprous chloride is collected in a filter press and can be smelted with limestone and coke, with the production of copper and calcium chloride slag. The copper thus produced will be used for making the shot. The solution, freed from its chlorine content, is electrolysed, using anodes made of magnetite and ordinary copper cathode starting-sheets. Particulars of these anodes are given in another paragraph in this issue. The solution as it enters contains about 5% copper and from 2½ to 3% free acid, and leaves the last vat with 1½% copper and 8 to 9% free acid. As no arsenic or antimony is present, the quality of the cathode is high.

The first unit of plant now building has a capacity of 10,000 tons of ore per day. The ore will be crushed to ¼ in. mesh, and sent to six leaching vats, each 110 ft. wide, 160 ft. long, and 16 ft. deep, made of reinforced concrete and lined with 1½ in. of mastic asphalte, which consists of refined Trinidad asphalte mixed with crushed quartz or granite. The ore is distributed by belts and a travelling bridge, and is afterward removed by a grab-bucket on an unloading bridge. The solution is removed from the vats by 6 in. openings, eight to each vat. In each vat is a filter consisting of coco matting between two sets of planks, raised a few inches from the bottom of the vat. The circulating pipes are made of iron lined with lead, and the pumps are made of type-metal. The cycle of leaching operations requires 6 days, one for filling, two for leaching, two for washing and draining, and one for discharging. The solution will go to storage tanks, of which there are nine, two of them measuring 12 by 130 by 150 ft., and seven 12 by 70 by 150 ft. From these it will be sent to 21 revolving steel drums each 30 ft. long by 4 ft. diameter, lined with earthenware, and half filled with copper shot. The cuprous chloride formed will be saved in Dorr thickeners made of concrete and lined with mastic asphalte. The solution will then go to 510 electrolytic vats, each 19 ft. long, 3½ ft. wide, and 4 ft. 10 in. deep, also made of concrete and lined with mastic asphalte ; 30 of the vats will be used for making starting sheets, and the others will be arranged in 5 electrical circuits and 30 solution circuits, the solution in each circuit flowing through 16 vats placed in cascade. The magnetite anodes will be 4 ft. long, 5 in. wide and 2 in. thick, and will be placed 5 to a bar. The cathode starting-sheets will be 3 ft. wide and 4 ft. deep.

Magnetite Anodes.—The *Engineering and Mining Journal* for April 25 gives some particulars of the magnetite anodes made by the Chemische Fabrik Griesheim Elektron, of Frankfurt am Main, Germany, and adopted by the Chile Exploration Co. for the treatment plant at Chuquicamata. The advantage of magnetite in electro-chemical operations is that it is unaffected by oxygen, chlorine, or SO_4 ions. Hitherto, difficulties in manufacture has stood in the way of the adoption of this type of anode, for impurities have generally been present that soon caused a serious diminution of mechanical strength. According to the method for making the anodes adopted by the Griesheim works, ferric oxide, Fe_2O_3, is used as the source of the magnetite. On melting the Fe_2O_3, oxygen is liberated and magnetite, Fe_3O_4, formed, together with a small amount of ferrous oxide, Fe O. The formation of the latter has been a source of trouble, for two reasons. In the first place, it does not crystallize uniformly with the magnetic oxide and so may cause fracture on cooling ; and second, it does not resist the attack of chlorine and therefore renders the anode easily destructible. The Griesheim invention consists of a method of preventing the formation of the Fe O. This is done by adding to the fused mass a small calculated quantity of pulverized Fe_2O_3, which combines with the Fe O present to form Fe_3O_4. It is necessary to add sufficient Fe_2O_3 to combine with all the Fe O ; to have an excess does no harm, as the Fe_2O_3 dissolves in the melt and crystallizes homogeneously. By adding the Fe_2O_3 in powder form and not melted, the temperature is kept sufficiently low to prevent any Fe O being left uncombined. Other oxides could be used in place of Fe_2O_3, such as Cr_2O_3 or Mn_2O_3. The melt is poured into moulds and after the exterior portions have solidified to ¼ in. in thickness, the central part, still molten, is withdrawn. The inside of the hollow electrode is coated electrolytically with copper, and copper contact-strips are attached. The use of the internal coating of copper is to ensure that the current is equally distributed. It is stated that the Fe_2O_3 employed is the cinder left after the roasting of pyrite from Rio Tinto. This contains some silica, which is supposed to be in some way beneficial to the process, possibly by combining with the Fe O. The anodes are susceptible to sudden changes in temperature and they are brittle. Great care has therefore to be taken in handling them, and their life is determined entirely on mechanical considerations.

Bawdwin Mine, Burma.—As we recorded in our issue last month, additional capital has recently been provided for the purpose of further developing the Bawdwin mine in Burma. The money has been provided by the Burma Corporation, which was formed for this purpose in October last year. The directorate consists of H. C. Hoover, R. Tilden Smith, F. A. Govett, R. Gilman Brown, T. J. Hoover, and E. Heberlein. It will be remembered that the Burma Mines company was formed in 1906 by Bewick, Moreing & Co., as a reconstitution of a company formed in 1904, to acquire a lead-silver mine and heaps of ancient lead slags at Bawdwin, near Lashio, in the Northern Shan States of Burma, not far from the Chinese border. The treatment of the lead slags yielded some profit, but the funds so obtained together with much additional capital were spent in reopening and exploring the mine. Development was hindered by the large amount of water, and it was only by driving a drainage adit that further work was made possible. The orebodies were discovered to be of great extent and width, and to consist of mixed sulphides similar in character to those of Broken Hill. As recorded in our last issue, the Burma Corporation has recently issued 100,000 shares, bringing the total issued capital to £757,410, and has given a call on 20,000 further shares. A pamphlet has been issued containing a report on the properties signed by the Technical Committee of the Corporation, which is composed of R. Gilman Brown, Theodore J. Hoover (alternate A. F. Kuehn), and E. Heberlein. We give herewith an abstract of this report and reproduce some of the drawings attached to it.



Vertical Section and Plan of Bawdwin Mines, Burma.

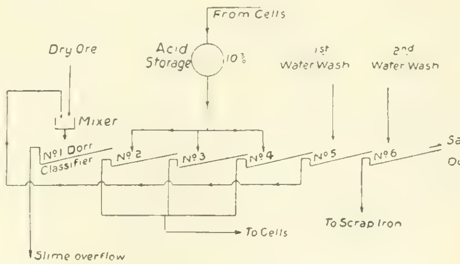
The ore-channel of the Bawdwin mine is from 350 to 500 ft. wide and has been traced for 8000 ft. The active work by the ancients and by the present company has been confined to the northern 4000 ft. The ore occurs in nearly vertical shoots, with a hanging wall of felspathic grit, and a foot-wall usually of rhyolite, and sometimes of felspathic grit. The ore-channel is covered by more recent sedimentaries, which have been eroded at the northern end so as to expose the ore. The rocks in which the orebodies are found have been called the Bawdwin series, and the overlying sedimentaries the Banyan series. The ancient workers had mined the outcrop of oxidized lead ore, apparently with the object of extracting the silver The work inaugurated by the present owners has been devoted to the development of the sulphide zone, and may be roughly divided into three sections, namely, the Vertical shaft, Chinaman tunnel, and Tiger tunnel sections. The Vertical shaft has been sunk to 434 ft., at a point 1400 ft. from the north end of the ore-channel. Cross-cuts have been driven at the 102-ft. and 171-ft. levels intersecting old workings. The 300-ft. level is in virgin ground. A cross-cut is now being driven at the 430-ft. level. In this section two lodes have been proved, called the Burman and the Shan. On the 300-ft. level the Burman lode for a distance of 190 ft. has an average width of 31 in., assaying 33% lead, 16% zinc, and 37 oz. silver per ton, with a trace of copper. The Vertical shaft cut the lode at 410 ft. The Shan lode is parallel to the Burman, about 150 ft. to the east At the 300 ft. level a cross-cut proved the lode to contain copper as well as lead and zinc. The assays showed 99 ft. on the northern side, 4·1 ft. thick, to average 11·2 % lead, 1·5 % zinc, 1·9% copper, and 8·4 oz. silver, while 150 ft. of the southern part averaged 17 ft. in thickness and assayed 15·4% copper and 7·8 oz. silver.

The Chinaman tunnel enters at a point 3650 ft. south and 100 ft. west of the Vertical shaft, and intersects the ore-channel 1887 ft. south of the shaft, at a horizon corresponding approximately to the 171-ft. level in the shaft. The core of the Chinaman orebody consists of zinc-lead sulphide, about 500 ft. long and 44½ ft. wide, assaying 29·6% zinc, 26% lead, and 23·6 oz. silver per ton. This core is enveloped by ore higher in lead, to a thickness of 29 ft. and assaying 24·3% lead, 14·2% zinc, and 17·5 oz. silver. Then comes a zone of ore of lower grade, 70 ft. wide. The total length of the orebody on the 171-ft. level is 1187 ft. The lower-grade ore is not reckoned in the estimate of reserve; it averages 7% lead, 5% zinc, and 5 oz. silver. Two other smaller orebodies have been intersected in the crosscuts.

The Tiger tunnel is being driven with the object of providing a working entry to the mine. Its portal lies on the Sterne river, at a point convenient for access to the company's smelter at Nam Tu. It will be about 6000 ft. long, and will enter the ore-channel in the manner indicated in the plan, 500 ft. below the Chinaman tunnel and 660 ft. below the collar of the Vertical shaft.

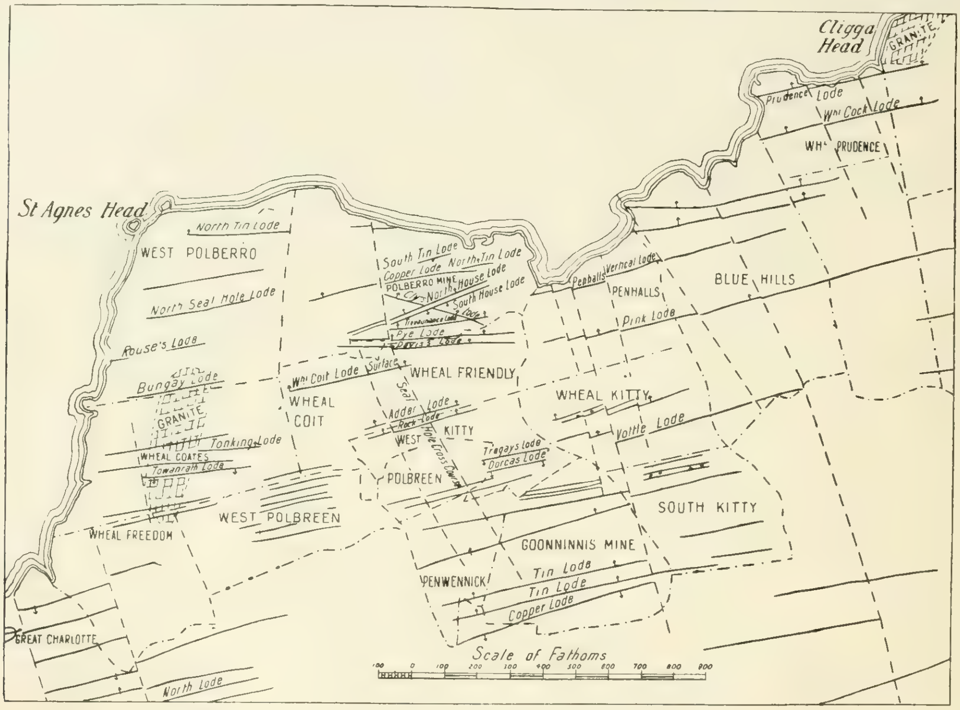
The estimates indicate 1,154,000 tons of ore as reasonably assured, with further excellent prospects at depth. The most profitable method of ore-treatment is being studied, but in the meantime the zinc-lead ore is saleable to European smelters, who during the last few months have taken 7488 tons. The profit to the company on the sale of the ore in this way would be £2 to £2½ per ton, with the value of the total metal contents at £13 per ton. The purposes to which the present issue of capital is being devoted are: the completion of the Tiger tunnel, the rebuilding of the branch railway, the erection of a concentration plant, the installation of a hydro-electric power-plant, and sufficient development to render possible the extraction of 300,000 tons of ore annually. It will take 2½ years to complete this programme, and during the time it is intended to ship 2500 to 4000 tons of zinc-lead ore per month and to continue smelting either on picked lead ore or on the copper-silver ore. This can be sold in Europe at £4. 15s. per ton.

Leaching at Butte-Duluth.—In our issue of December last we gave a précis of a paper describing the leaching and electro-deposition of copper from oxidized copper ore at the Butte-Duluth mine, Montana. According to the process then described, the ore was crushed to half-inch and leached in vats. It was found however that the percentage of recovery was not high, ranging from 50 to 70%, but any finer crushing prevented proper percolation. It was decided therefore to keep the mass moving by using modified Dorr classifiers. This method has proved successful. C. S. Herzig described the installation in a paper read before the Institution of Mining and Metallurgy in May. The first plant consisted of five classifiers made of wood each 4 ft. 6 in. wide and 15 ft. long, placed in series. The first three were used for leaching and the last two for washing. This arrangement did not provide sufficient time of contact of the acid with the ore, so two classifiers double the length of the others were added in front. It is intended also to lengthen the other three. A new set of machines is now being erected 8 ft. wide, the first four for leaching being 30 ft. long, and two for washing each 15 ft. long. They are to be operated at 4 strokes per minute, and contact

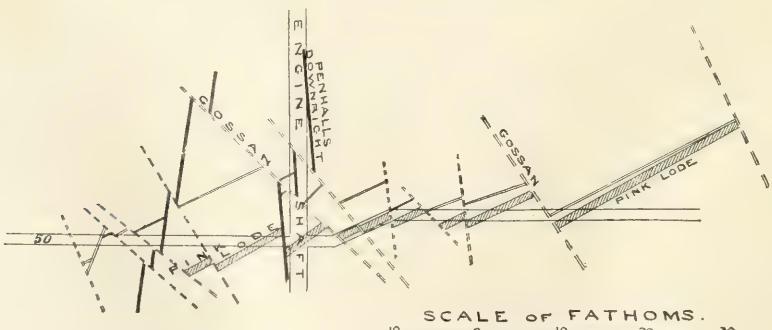


of ore and acid will occupy an hour. It is stated that an extraction of 85% is obtainable. The accompanying illustration shows the arrangement diagrammatically. Each machine is set with an overlap of 3 ft. and set at a slope of ⅞ in. per ft. The troughs are made of Oregon fir, and all the parts coming in contact with acid are made of hard maple. The ore is fed to the first classifier, and acid solution added. Probably this will be altered by preliminarily mixing the solution and ore before delivery to the first classifier. The slime discharges over the bottom end and is collected in one of the old leaching vats, in the bottom of which a bed of crushed ore is placed to act as a filter. The coarse pulp passes over the head of the first machine and drops upon the second, the percentage of moisture in the discharge being arranged at 25%. A fresh solution of acid is added to No. 2 machine, and so on through the 3rd and 4th. The last two are fed with wash water, that coming from the first passing to the first leaching machine for addition to the dry ore, and that from the second being passed over scrap iron for the precipitation of copper and discharged to waste. It will be seen that only the sandy product is being treated at present, but the engineers of the Dorr Machinery company are experimenting with a view of devising an agitation method for the slime. It is stated that at present the separation of the slime acts beneficially, as with it is removed a large proportion of the iron and aluminium salts, thus eliminating them from the solution to be electrolysed. Moreover, the absence of slime means that much cupriferous solution is not wasted.

Tin Deposits at St. Agnes, Cornwall.—At the meeting of the Cornish Institute of Engineers held at Camborne on May 16, J. S. Whitworth read a paper describing the economic geology of the St. Agnes district of Cornwall. This district, to the north of Redruth, is notable because the tin lodes are found in the killas, or Devonian slate, and not in the granite, as is usual in Cornwall. Another source of interest is the unusual amount of faulting, in a number of directions. Mr. Whitworth's paper is of value at the present time seeing that it may evoke useful discussion and thereby help the companies now operating in that district, the Wheal Kitty and West Kitty. The rocks of the district, as already mentioned, are Devonian sedimentaries, but at Cligga Head and on St. Agnes Beacon there are outcrops of granite. It is generally considered that these outcrops are off-shoots from the granite of the Camborne district. The granite at both places shows signs of greisenization and kaolinization, and the slates are metamorphosed near the granite. A great dike of quartz-porphyry, called an 'elvan' in the Cornish terminology, extends through the granite at Cligga Head, through the altered killas near the Beacon, and for many miles farther west. As regards the lodes formed subsequently, the author divides them into four classes, and compares his classification with that of Joseph Carne, published in 1822, who recorded eight different epochs of formation. These lodes are not all ore-bearing; some have hardly a trace of tin and copper minerals; and others have sufficient cassiterite and pyrite to interest the geologist but not the miner. The author laments the fact that the absence of ore has caused many lodes and veins to be neglected, though a study of them might have

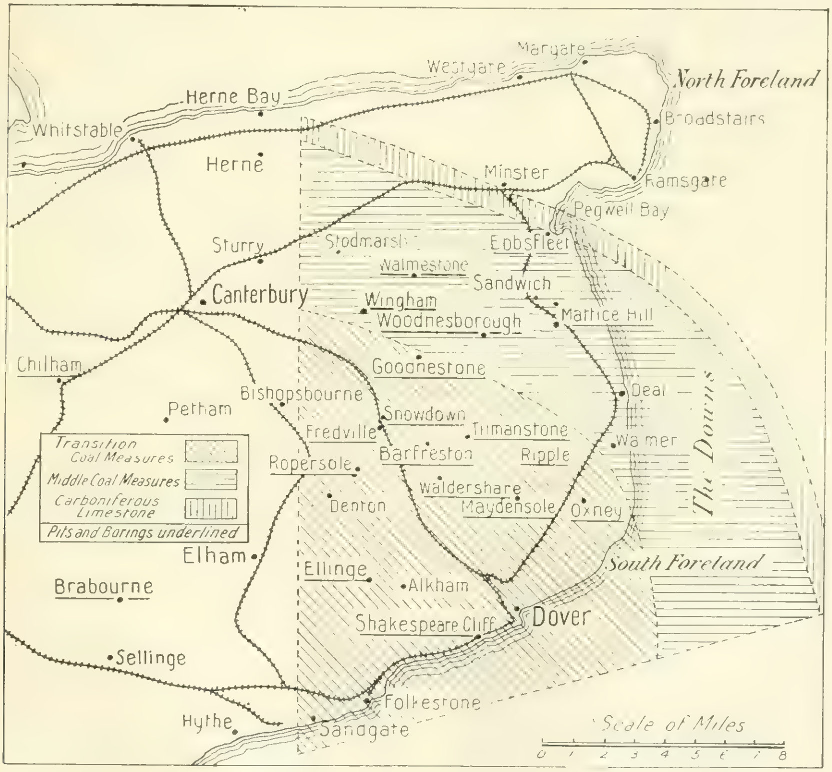


THE LODE SYSTEM AT ST. AGNES.



SECTION ACROSS PINK LODE, ST. AGNES.

helped to unravel the great complications characteristic of this district. The main tin lodes have generally an east-west strike, varying to northeast-southwest, with a dip usually to the north. These have been formed at two periods; those formed first generally have a flat dip to the north. A good example of this class is the Pink lode in Penhalls, belonging to the Wheal Kitty company. The later lodes have a steep southerly dip, and fault the earlier ones. At Penhalls, the Downright lode forms a good example. The accompanying illustration shows these lodes. The second series of lodes, included in the 3rd and 4th divisions of Carne, are locally called 'gossans,' though this term is not indicative of the modern sense of the word. It is used to denote lodes consisting of quartz is rare that any other mineral is present. As an example of the extent of faulting, the case of Wheal Kitty may be quoted again. Here the main cross-course leaves the Pink lode 162 ft. to the south in plan; it leaves the main 'gossan,' which dips south, 84 ft. to the north. In this mine there is also a good example of a lode being entirely lost, namely, the Wheal Vottle. In driving on this lode, which is nearly vertical, a cross-course was intersected, and all attempts to find the continuation of the lode have so far proved futile. Mr. Whitworth's paper serves to remind modern readers of the unusual difficulty in following lodes in the St. Agnes district, though most of them are aware of the writings on the same subject by J. H. Collins and Donald MacAlister.



THE KENT COALFIELD.

and clay, containing some iron and copper pyrite. These dip to the south and pass through the two sets of tin lodes, faulting them in nearly every case. It is supposed by some authorities that these 'gossans' correspond to the copper lodes formerly worked to advantage near the surface in other parts of the district.

The next class consists of cross-courses, which usually bear north and south and dip easterly almost vertically. These all fault the tin lodes and 'gossans,' increasingly so as their dip becomes flatter. They consist almost entirely of quartz, with some clay. When the proportion of clay is large, they are called 'fluccans.' The fourth division consists of slides. These fault all the other types above-mentioned. Their strike is more north of east than that of the 'gossans,' and their dip is more often south than north. They consist entirely of clay and quartz; it

Geology of the Kent Coalfield.—At the June meeting of the Institution of Mining Engineers, E. A. Newell Arber read a paper on the geology of the Kent coalfield. We have on previous occasions, notably in our issues of July 1912 and March 1913, given accounts of the development of this coalfield. Mr. Arber is demonstrator in paleobotany in the University of Cambridge, and his studies in connection with Kent coal have been concerned largely with the correlation of the buried Coal Measures and the lower Paleozoic rocks, based on the examination of plant remains. By means of these investigations and by the results disclosed by bore-holes sunk by the various operating companies, he has been able to present a contour map of the Paleozoic floor, and a map showing the probable distribution of the Paleozoic rocks. The latter we reproduce herewith in modified form. In examining these maps it has to be remembered that the Coal Measures and other Paleozoic rocks are covered to a depth of over 1000 ft. by a blanket of Mesozoic rocks of which the chalk is the thickest. The proved area of Coal Measures extends over 200 square miles, including the strip of 3 miles round the coast. Probably another 50 square miles might be added to the area at distances farther out to sea, but no information regarding them is available and the coal would not be extractable. This area is smaller than the coalfields of Newcastle, Yorkshire, or South Wales, but it is larger than most of the others, and it is of greater economic importance. Mr. Arber in his paper gives a résumé of the history, recounting how Godwen-Austin predicted the existence of such a coalfield in 1856, and how Professor Boyd Dawkins was able to prove the correctness of the theory, and he apportions to Arthur Burr the due credit for the development of the deposits on a practical scale. The delay in proving and opening the coal seams has already been explained by the chronic state of shortness of funds and the immense amount of water encountered in the chalk. But Mr. Arber adds another reason ; that is to say, the difficulty of getting English firms to undertake rapid boring. In fact it was not until 1910 when Belgian and German firms, the Trefor Company, of Brussels, and the Internationale Bohrgesellschaft, of Erkelenz, undertook the work that speed was attained. Mr. Arber proceeds to describe the results obtained at each boring and to give his deductions therefrom. As regards the shape of the coalfield, he concludes that it is a syncline suddenly truncated on the west, with an anticline to the south under the Straits of Dover. The northern boundary has been fairly closely ascertained by the presence of Carboniferous limestone. As regards the eastern boundary, he considers that it consists of a north-south anticline. The continuity of the coalfield with the buried Pas-de-Calais coalfield on the French side of the straits has always been a matter of speculation. Mr. Arber's facts, however, show that the Kent coalfield has a southern boundary on the side of an anticline about eight miles from the coast between Dover and Folkestone. His description of the west boundary seems to us to be not quite clear. As regards the identity of the rocks, the Coal Measures consist of the Transition series, from 1700 to 2000 ft. thick, immediately under the Mesozoic rocks, and the Middle series farther below about 2000 ft. thick. The Lower series and the Millstone Grit are not represented. The Coal Measures are consistently grey sediments. No red rocks, Epsley beds, or *Spirorbis* limestone, occur. No igneous rocks have been found, and ironstone and limestone are either rare or entirely absent. The dominant types are sandstones and shales. Clays appear to be rare, though numerous beds of fire-clay are often found under the coal seams. Dark carbonaceous shales are common, and here and there thin beds of conglomerate or breccia are found. As to the coal seams, these have the characteristic of frequent splitting and of thickening and thinning laterally. This makes the correlation of seams in the various borings a matter of difficulty. There is no main thick seam, but several workable seams are distributed through the Measures. The best seams are in the lower part of the Transition series and in the upper part of the Middle series. The Tilmanstone and Snowdown collieries are working seams in the Transition series, where the thickness is from 4 to 5 ft. The Middle series carries more workable seams, and some are of considerable thickness, one being as much as 11 ft. In the two collieries named, boring has proved the existence of Middle seams at a greater depth.

As a supplement to Mr. Arber's paper it is of interest to record that four chief companies are at work on the coal. Mr. Burr's territory is extensive and centres round the Snowdown and Tilmanstone shaft, continuing east to near Deal and north to near Canterbury ; the Channel Collieries Trust (Dorman-Long and Bell interests) have the country from Dover to Deal along the coast and out to sea ; the Anglo-Westphalian is sinking in the far northwest of the coalfield ; and the Betteshanger is drilling in the northeast. The Channel Collieries Trust is also working ironstone in the oolite of the Mesozoic blanket near Dover, of a nature similar to that smelted at Westbury in Wiltshire.

Electric Smelting of Zinciferous Ores.—The *Bulletin* of the Canadian Mining Institute for April contains a paper by Woolsey Mc. A. Johnson, describing his furnace and process for the treatment of complex zinciferous copper and lead ores. According to this process, the ore is first roasted so as to reduce the sulphur content to about 4 to 6%, then it is pre-heated and pre-reduced in a muffle furnace with an admixture of bituminous coal so as to reduce much of the iron oxide to metallic iron, and finally it is reduced in the electric furnace with the formation of (1) metallic zinc, which is volatilized, (2) copper matte, (3) lead bullion, and (4) slag. It is stated that on an average 60% of the zinc is recovered as blue powder and 40% as spelter, and that the metallic content of the slag is remarkably low. As regards costs, Mr. Johnson quotes the results of a test on a mixed charge running about 35% zinc, 9% lead, 1½% copper, 10 oz. silver, and 4 dwt. gold ; the energy consumption was 1490 kilowatt-hours per ton of charge, and the consumption of electrode 6 lb. per ton. In the discussion on the paper, W. R. Ingalls and Alfred Stansfield spoke of the high cost due to the great amount of current required.

CURRENT LITERATURE

Concrete Lining for Shafts.—In the *Engineering and Mining Journal* for May 16, Robert H. Dickson describes the method of lining with concrete one of the shafts of the Calumet & Arizona company's mine at Bisbee.

Stope-Filling.—At the May meeting of the Manchester Mining & Geological Society, J. Drummond Paton described modern methods of supporting roofs in coal mines by 'hydraulic stowing.'

Stope Filling.—Bulletin 60 of the United States Bureau of Mines contains a description by Charles Enzian of the methods of hydraulic mine-filling adopted in the Pennsylvania anthracite region.

Electricity in Mines.—The Bureau of Mines of the United States has issued a report on the action of acid mine water on the insulation of electric conductors. It is written by H. H. Clark and L. C. Ilsley, and is published as 'Technical Paper 58.' The contents relate chiefly to a recital of the causes of deterioration of the insulation and to the preliminary experiments undertaken. The investigations are to be continued in great detail.

Rock-Drill Repairs.—In the Columbia *School of Mines Quarterly* for January, C. K. Hitchcock presents a record of the cost of repairs to rock-drills used at the Lake mine, Michigan.

Arnold Concentrator.—*Mining Science* for May describes a concentrator invented by G. W. Arnold in use at Lawson, Colorado. It consists of a pan inclined at an angle and slowly revolved ; the bottom is fitted with spiral riffles ; the ore is fed near the bottom ; the heavier particles are carried upward by the riffles and discharged through an orifice in the centre, while the gangue is washed over the sides.

Anaconda Slime Treatment.—In the issue of the *Engineering & Mining Journal* for May 9, W. R. Ingalls describes the multiple-deck round tables erected at Anaconda for the concentration of slime.

Diamond-Winning.—The April issue of the *Journal* of the South African Institution of Engineers contains a paper by James Stewart describing the plant used by the De Beers company for extracting diamonds from the blue ground.

Cyanide Practice.—In the *Engineering & Mining Journal* for May 2, Donald F. Irvin describes the methods adopted by the Tigre Mining Co. for recording operations and checking production at metallurgical works, especially in connection with the bullion from the cyanide plant.

Commonwealth Mine, Arizona.—In the *Mining and Scientific Press* for May 2, E. H. Leslie describes the metallurgical plant at the Commonwealth gold mine, Arizona.

Gold Mining in Korea.—In the *Mining and Scientific Press* for May 9, A. E. Drucker gives an outline of gold-mining operations in Korea.

Colombian Mining.—In the *Engineering & Mining Journal* for May 2 and 9, R. W. Perry describes lode-mining operations throughout Colombia.

Wisconsin Lead.—In the *Mining and Engineering World* for May 2, H. B. Pulsifer commences a history of lead mining and smelting in Wisconsin from the earliest times.

Kirkland Lake.—In the *Canadian Mining Journal* for April 15, Reginald E. Hore describes the Tough-Oakes mine at Kirkland Lake, the geology of the region, and the nature of the ore deposit

Molybdenite in Queensland.—In the *Queensland Government Mining Journal* for April, E. C. Saint-Smith describes the molybdenite deposits in the Stanthorpe and Ballandean districts of south Queensland.

Etheridge, Queensland.—The *Queensland Government Mining Journal* for April prints Lionel C. Ball's report on the Etheridge mineral division of north Queensland.

Mine-Waters.—*Economic Geology* for April contains a paper by Alfred C. Lane detailing investigations of the alterations in the constituents of stagnant mine-waters undertaken with a view of studying the course of ore-bearing currents.

Origin of Petroleum.—The *Bulletin* of the American Institute of Mining Engineers for May contains a paper by Hans von Höfer on the origin of petroleum, being concerned particularly with a criticism of Eugene Coste's arguments in favour of the inorganic theory.

Surface Combustion.—The *Engineer* for May 15 commences a series of articles descriptive of the surface-combustion process introduced by Professor W. A. Bone. We gave an outline of this process in our issue of January 1912.

Prat's Induced Draught.—*Engineering* for April 24 contains a description of Prat's system of induced draught, largely used on the continent. The steel chimney is wider at the top than bottom and the fan is not in the direct circuit of the combustion gases.

Anaconda Electric Railway.—The *Engineer* for April 24 describes the electric railway connecting Anaconda and Butte.

Bessemer Steel.—The *Iron & Coal Trades Review* for May 8 publishes a paper by Ernest F. Lange containing researches into the early history of bessemerizing, more particularly in connection with the work done in developing the idea by the Swedish engineer, G. F. Göransson.

Flotation Litigation.—The *Mining and Scientific Press* for May 9 prints in full the decision of the United States Appeal Court on the Minerals Separation v. Hyde litigation. The subject is discussed in our editorial pages.

NEW BOOKS

Igneous Rocks and their Origin. By Reginald Aldworth Daly. Cloth, octavo, 560 pages, illustrated. New York: McGraw-Hill Book Co. Price 17s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Mr. Daly occupies the position of Professor of Geology in Harvard University, and, indeed, received much of his own training in the efficient petrological department of that institution. Perhaps no man is better qualified, both from his field and laboratory experience, to undertake the arduous task which the author set himself. He has succeeded in producing a valuable work.

Mr. Daly, with a profound knowledge of his subject, presents a mass of evidence to substantiate his belief that the earth's crust consists of thin concentric shells. The outer discontinuous and ever-changing one is sedimentary in make-up. Underlying this are two envelopes, the upper acid or granitic, the lower probably basaltic or gabbroidal. The granitic shell is practically continuous in extent, and is visible to human activities in places, as, for example, where pre-Cambrian rocks are exposed. The basaltic shell is not visible, but is the assumed reservoir and potent agency to which the volcanic activity of the world is due. With the exception of the upper part of the granitic shell, both it and the basaltic shell are magmas in a fluid state. So tremendous is the power of the all-enveloping hot basaltic magma that it, as a primary force, drives molten wedges of great dimensions toward the earth's surface, which wedges cut, and even 'stope' their way through superincumbent masses of the granitic and sedimentary envelopes. It is only the topmost pinnacles and bosses of these great wedges, chemically modified in composition by the nature of the rocks through which they pass and parts of which they assimilate, that appear in a cooled, frozen, or crystallized state as the laccoliths, sills, and dikes of igneous rock visible to man. The genetic history of practically every igneous rock mass of the earth's surface may, if I understand Mr. Daly correctly, be traced to its great ancestor the basaltic magma, plus some other parent, generally the granitic magma, and less frequently either the sediments or previously erupted volcanics or injected plutonic rocks which the basic primal lava has encountered en route.

Mr. Daly happily avoids the error of departing from the older or Rosenbusch classification of igneous rocks. Certain American petrographers in recent years have introduced an elaborate system of rock-classification, based on assumptions concerning chemical affinities. Owing to the startling novelty and multiplicity of super-technical terms with which this new system was burdened, leaving out of the question its somewhat dubious value, it has fortunately not found general acceptance among petrographers.

Starting, therefore, on a sound and accepted basis, the author proceeds to develop a theory of vulcanism that merits the attention of geologists. The ideas expressed are fortified by the author's personal observation and experience in North America and Hawaii, and by an extensive compilation of the records of other observers in many parts of the world. So far as observed facts are concerned, especially relating to the outer shell and the underlying acid shell with their related phenomena, the evidence presented by means of numerous illustrations, comprehensive tabulations, and abundant references to literature is convincing. On the other hand, Mr. Daly is probably prepared to meet the objections which geophysicists may raise to his premises regarding the existence of the all-surrounding, deep-lying basaltic magma. It is fairly safe to assume, however, that the number of earth-students who could convincingly controvert the arguments advanced in this serious work is not large. While being careful not to use petrographic terms not sanctioned by general usage, Mr. Daly uses perhaps a too *ex cathedra* style in places, and also employs words, especially verbs, whose use is, to say the least, not usual. He does not always bear in mind that the beauty and the convincing power of language are dependent on simplicity.

The work is likewise marred by weakness in the matter of assemblage. It contains, if I may so express it, several argumentative anti-climaxes. Happily these are not intrinsic faults, and in future editions of the book we may look for improvements both in style and arrangement that will increase its literary value and convincing power.

We may also hope in another edition to see better printing and binding. It should further be said that the photograph of Mount Baker forming a frontispiece lacks significance, and its poor reproduction in the present form has no artistic value. A good wine needs no bush, neither does a treatise of great scientific value gain credit from a mere pretty picture which, unfortunately, is so labelled that it looks like an advertisement for a railway company.

Although Mr. Daly makes little reference to the relation of the igneous rocks to ore occurrences in specific cases, the student of ore deposits will do well to possess and carefully study this book. It deals with principles of fundamental importance and of fascinating interest to all who follow mining.

C. W. PURINGTON.

Manual of Petrographic Methods. By Albert Johannsen. Cloth, 8vo., 649 pages, 770 illustrations. New York: McGraw-Hill Book Co. Price 25s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Petrology has nowadays an intimate connection with the science of ore deposits; indeed, if we are to believe some authorities, ore deposition is merely a phase of the consolidation of igneous magmas. Mr. Johannsen's work, however, gives us no occasion to enter upon a discussion of this interesting question. It contains nothing to carry us into the realms of speculation. All is hard fact, based on physical and chemical principles as unchangeable as the laws of the Medes and Persians. The book deals exclusively with the methods that are available in conducting research work on rocks, or rather, for the most part, on the individual mineral grains of which rocks are composed, whether seen in thin sections or in the form of powder. In a work of this kind there is little opportunity for the author's individuality to make itself felt, though Sir Henry Miers, in his valuable treatise on 'Mineralogy,' has shown that it need not be entirely suppressed. The author of the volume now under consideration has not the lucidity of style that makes Sir Henry's review of the optical properties of minerals comparatively light reading, but that is not to say his task has been ill done. The real test in a reference work like this is the completeness and accuracy of the information it affords. Of course personal predilection leads each of us to prefer particular methods of exposition in individual cases, or to consider certain sequences most logical, but to insist upon such points would be to allow prejudice to outweigh judgment. Mr. Johannsen shows that he has had much practical experience as a teacher, and that he has profited by it, a thing just as easy for teacher as student. This is exhibited especially in his references to certain sources of error; for instance, he twice refers at some length to those irritating uniaxial interference figures, due to the lenses themselves, which often perplex the student occupied with microscopical work. Among the heavy liquids and melts there is no mention of lead potassium nitrate, which is sometimes convenient for work on large quantities of material, or for preliminary separations. On the other hand, we are introduced to a number of devices, some of them due to the author himself, which are likely to prove useful. Mr. Johannsen set out, as he tells us in his preface, to fill an obvious gap among the petrological treatises written in English, and he has done his work with much industry and a considerable amount of discrimination.

F. P. MENNELL.

Canadian Mining Institute Index. By H. Mortimer-Lamb. Octavo, paper covers, 488 pages. Montreal: Office of the Institute.

Considering the relatively small value of its mineral output and the great tract of country over which the productive areas are distributed, Canada is unusually well served by three 'institutions,' inaugurated for the advancement of its mining interests, that is to say, the Ottawa Department of Mines, the Canadian Mining Institute, and the *Canadian Mining Journal*. The success of the second named during recent years is largely due to the efforts of the secretary, Mr. H. Mortimer-Lamb. His latest enterprise is the compilation of an index to the Transactions, the first part of which, covering Volumes 1 to 10, from 1898 to 1907, has just made its appearance. Nobody knows better than we do the difficulties of preparing an index, and we therefore feel competent to appreciate Mr. Mortimer-Lamb's novel method. He has approached the subject from the point of view that a full index leads to disappointment on the part of the searcher owing to so many of the references being of trivial or subsidiary importance. To help the searcher he has added a brief outline or summary of all the papers presented, and in the index proper, reference is made to these summaries as well as to the original volumes. In this way the inquirer will be able to judge whether the information is what he requires or not, and whether it is worth while pursuing investigations along each particular line. This arrangement is particularly useful, because back volumes of transactions of any society are not always readily available.

Preparation of Metallic Cobalt. By H. T. Kalmus and others. Octavo, paper covers, 50 pages, illustrated. Ottawa: Department of Mines.

This pamphlet contains an account of researches on cobalt and its alloys, particularly with regard to the reduction of oxide to metal in the electric furnace.

Atlas de Geologie Economique. By Léon Demaret. Portfolio, 100 pages of maps. Mons, Belgium: Charles Delporte et Fils. Price 6s. 6d.

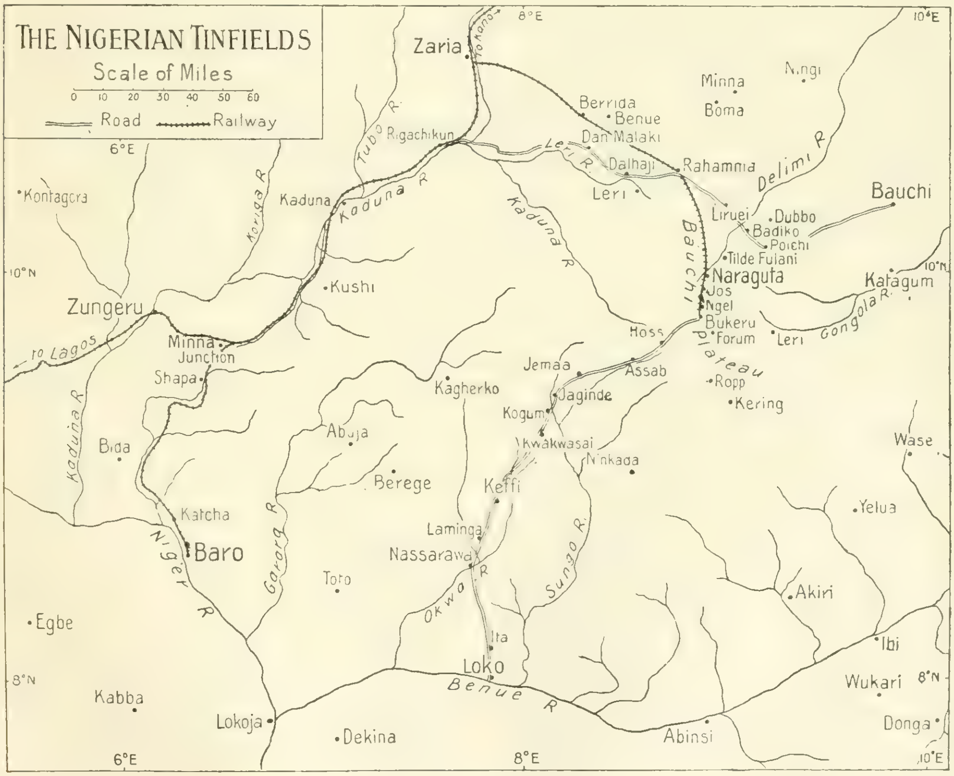
This is a folder containing 100 sheets of illustrations of geologic structure as affecting the distribution of ore. They are extremely suggestive and ought to prove convenient to mining geologists. Mr. Demaret is Engineer in Chief in Belgium, and professor of geology at Mons.

COMPANY REPORTS

Bisichi Tin.—This company was formed in 1910 to acquire property in the Bauchi province, Northern Nigeria, about 16 miles south of Naraguta, and between Forum and Bukeru, as shown on the accompanying map. Operations commenced at the beginning of 1911. A dam has been built across the Bisichi river, and the water is conveyed by pipe-line to hydraulic elevators and monitors at various places. During the year 1913, covered by the report now issued, 370 tons of concentrate was recovered, and the net receipts after payment of freight were £35,813. The working cost was £15,622, London expenses £2990, and allowance for depreciation £2136. The net profit was £15,914, out of which £16,000 has been distributed as dividend, being at the rate of 8%. Horace P. Robertson, the manager, reports the proved reserve of alluvium at 1,553,399 cubic yards, containing 2350 tons of black tin, being an average of 3·5 lb. black tin per yard, and he estimates that other ground will probably contain 1950 tons of black tin.

Kaduna Syndicate.—This company was formed in August 1910 with a capital of £10,000, and owns alluvial tin areas in the Arim district of the Bauchi province, Northern Nigeria, about 16 miles southwest of Bukeru. J. W. Anderson is managing director, Lake & Currie are the consulting engineers, and J. E. Snelus is manager. The report for the year ended October 31 last shows that 199 tons of tin concentrate was produced, and 153½ tons sold, which brought a net income of £18,494 after freight and treatment charges were paid. After paying all costs, allowing for depreciation, and placing £2000 to reserve, the profit was £4297, out of which £3000 has been distributed as dividend, being at the rate of 30%. Debentures to the extent of £15,000 are now being issued for the purpose of providing funds for the acquisition and development of additional leases.

Tronoh Mines.—This company was formed in 1901 to acquire, from Chinese owners, alluvial tin mines in the Kinta district of Perak, Federated Malay States. The property is an extensive one. Up to the present time, operations have been centred on a lead of unusual richness, and large profits have been made, in spite of one or two setbacks due to irregularity in the methods of working and collapses caused by unexpected floods. The total dividends have amounted to £630,423, on a capital of £160,000, and £256,132 has been written off against purchase price and depreciation. Moreover, the company has a cash reserve fund of £66,235, and investments in other mining properties, including the Sungei Besi, Tronoh South, and Rambutan, valued at £62,400. The report for 1913 shows that 758,973 cu. yd. of overburden was removed and 577,930 cu. yd. of alluvium washed, for a yield of 36,747 piculs, equal to 2187 tons, which sold for £268,001. The profit was £59,806, and £60,000 was distributed as dividend, being at the rate of 37½%. Though the amount treated was 80,000 cu. yd. greater than in 1912, the yield of concentrate was 589 tons less, the average extraction having fallen from 12·52 to 8·48 lb. per cu. yd. The drop of £14 per ton in the price of tin adversely affected the income. In 1911 the yield



was 3856 tons of concentrate. With regard to the future of the company, the rich main lead is rapidly being exhausted, and delays have taken place in the preparation for the mining of the large low-grade deposits. No. 5 mine has proved disappointing and the big dredge will not be started until the ground has been re-sampled. No. 4 mine has not yet given satisfactory results and further prospecting is necessary. No. 6 mine and the South Lombong are about to become producers. C. V. Thomas is chairman of the company and Gilbert B. Pearce is on the board. J. H. Rich succeeded Harry D. Griffiths as manager a few months ago.

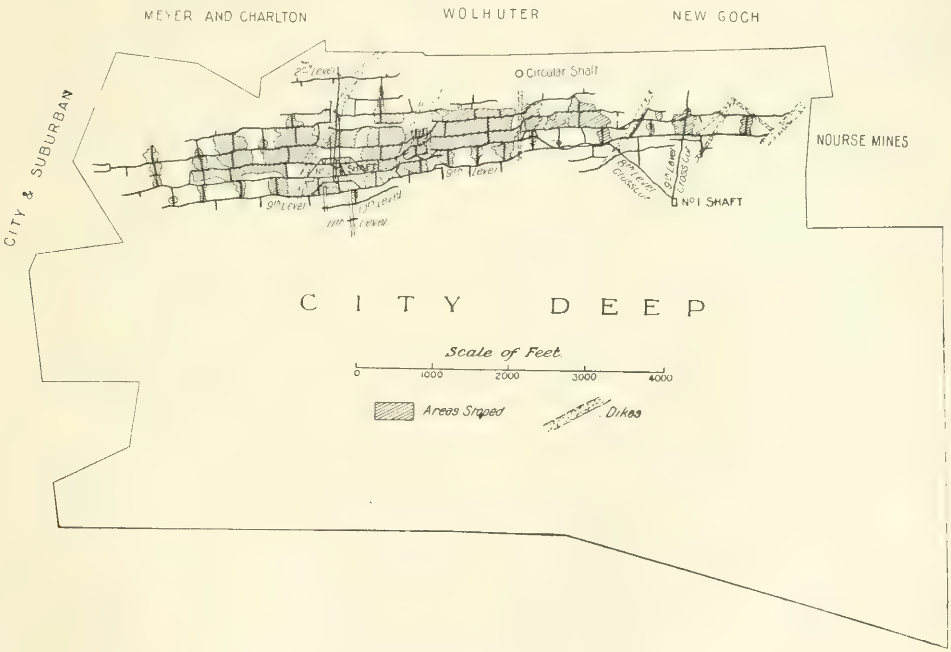
Hutti (Nizam's) Gold Mines.—This company was formed in the year 1901 to acquire from the Hyderabad (Deccan) Co. the Hutti gold mines, in the state of Hyderabad, Central India. Milling was started in 1903 with 10 stamps, and a further 20 were erected later. Cyanide plant has been added recently and a Butters slime-plant is in course of erection. Dividends totalling 90% on a capital of £69,610 were paid from 1903 to 1910. Subsequently the orebodies showed signs of exhaustion, and a policy of further sinking and development had to be adopted. The report for 1913 shows that conditions have greatly improved as regards both mining and development. The tonnage raised was 26,175, yielding gold worth £77,341, of which £66,855 was recovered by amalgamation and £10,486 by cyanide. As compared with 1912, the tonnage was 4500 higher, and the gold recovered £17,341 more. The improved position is due to rich ore taken from the stopes between the 1840 and 1940-ft. levels, about 300 ft. south of the main shaft. The accounts show a profit of £19,825, out of which £10,441 has been distributed as dividend, being at the rate of 15%. The main shaft has been sunk to 2340 ft., at which point a level is to be driven. The 2140-ft. level has developed ore of high grade, though not to the same extent as the 2040-ft. level. The 2240-ft. level gave disappointing results for the first 300 ft. of driving, but subsequently an ore-shoot 4½ ft. wide averaging 15 dwt. was found. The reserve of high-grade ore on December 31 was estimated at 53,000 tons averaging 15 dwt. per ton. Machinery for providing compressed air, slime-plant, new head-gear, etc., has been erected during the year, and the cost paid out of revenue. The mine has suffered from its distance from the railways. It is announced that a railway is to be built from Secunderabad to Raichur, but plans for the continuation from the latter town to pass near Hutti have not yet been sanctioned. F. W. Grey is chairman of the board of directors and J. Douglas Hay is manager.

Roodepoort United Main Reef.—This company belongs to the Albu group, and was originally formed in 1887. The property is in the middle west Rand. At various times there have been rearrangements and amalgamations. In 1908 an amalgamation was effected with the Kimberley Roodepoort, and in 1910 a part of the deep levels was transferred to the New Steyn Estate. The deposits are irregular and of low grade, and the problem of earning a profit has been a difficult one. Dividends were paid from 1894 to 1910, the total distribution being £609,500. The present share capital is £460,000. The company is in debt to the General Mining & Finance Corporation, the parent company of the Albu group, to the extent of £259,250, the money having been advanced for the purpose of providing a modern mill in 1910 and of pushing development. The conditions at the mine and on the Rand generally have not yet permitted of the capitalizing of this debt. The report for the year 1913 shows that 353,255 tons of ore was raised, which, together with 5442 tons from the dump, was sent to the sorting station, where 15% was rejected as waste. The mill crushed 303,852 tons, and the yield by amalgamation and cyaniding was 67,489 oz. worth £285,606, being an extraction of 4·44 dwt. or 18s. 9d. per ton milled. An average of 50 stamps out of 100 were at work, as compared with 55 stamps during 1912, when 362,439 tons milled yielded 86,278 oz. gold worth £365,246, being 4·76 dwt. or 20s. 2d. per ton milled. The fall in the yield per ton is due chiefly to the mining of reclamation ore from parts threatened with collapse. Other items brought the total revenue for 1913 to £288,233, and the working cost was £273,813, leaving a working profit of £14,420. Out of the profit, £8063 was paid as contribution to the Phthisis fund, and £16,897 was due for interest on the loan. The ore reserve on December 31 was estimated at 370,732 tons averaging 5·3 dwt., as compared with 379,283 tons averaging 5 dwt. the year before. In addition, 189,000 tons partly developed is estimated to average 5·36 dwt., and 187,306 tons averaging 3·39 dwt. is returned as of uncertain value for mining purposes. Charles B. Brodigan is manager.

Aurora West.—This company belongs to the Albu group, and was formed in 1891 to acquire an outcrop property in the middle west Rand. Milling commenced in 1892, but was suspended in 1894. Another start was made just before the war, and afterward milling was not resumed until 1908. No dividend has yet been paid, and the company is saddled with a debt of £113,735 advanced by the parent company, the General Mining and Finance Corporation. The report for the year 1913 shows that 214,220 tons of ore was raised, and after the rejection of 20% waste, 170,411 tons was sent to the 80-stamp mill. The yield by amalgamation was 37,723 oz. and by cyanide 15,804 oz., a total of 53,527 oz., worth £226,522, being 26s. 6d. per ton milled. The working cost was £170,804 or 20s. per ton, leaving a profit of £55,718. This profit has however been entirely wiped out by the necessary allowance for depreciation. The ore reserve on December 31 was estimated at 554,909 tons averaging 5·7 dwt. per ton, the tonnage being about the same as the year before and the content half a pennyweight higher.

New Unified Main Reef.—This company belongs to the Barnato group. It has been reconstructed several times, with rearrangements of the properties owned. The mine as now worked adjoins the Consolidated Main Reef and Aurora West in the middle west Rand. Milling commenced in 1893, but dividends were not paid until 1908. The report for the year 1913 shows that J. G. Lawn, the consulting engineer, and W. A. Krige, the manager, have modified the method of exploitation by extracting larger quantities of lower-grade ore from the Main Reef, instead of depending so much on the Main Reef Leader, which has now been almost entirely developed. More ore can thus be mined and at a substantially lower cost. Moreover, large blocks in the South Reef will be rendered profitable. The tonnage mined during the year was raised by 15,065, the cost per ton was 17s. 7d. as compared with 21s. 3d. during 1912, while the gross profit was substantially the same. Much reclamation work is being done in the upper levels, and 13% of the ore mined came from that source. The amount of ore raised was 175,065 tons, and this, together with 1059 tons from the dump, was sent to the sorting station where 16% waste was removed. The mill, which contains 60 stamps and 1 tube-mill, treated 147,390 tons averaging 6·2 dwt. per ton, for a yield of 29,526 oz. by amalgamation and 14,461 oz. by cyanide, a total of 43,989 oz. worth £186,730, being 6 dwt., or 25s. 4d. per ton. The working cost was £129,866, leaving a profit of £56,863 or 7s. 8d. per ton. In addition 10,227 tons of accumulated slime yielded gold worth £3068 at a profit of £1714. The reserve on December 31 was 387,500 milling tons, calculated to yield 5·9 dwt. per ton. Out of the profit, £4590 was paid as tax and £1859 to the Phthisis fund, while £50,000 was distributed to shareholders, being at the rate of 20 per cent.

City Deep.—This company belongs to the Rand Mines group, and was formed in 1899 to acquire a property in the central Rand on the dip of the City & Suburban and Meyer & Charlton. In 1908 the deep levels adjoining on the east, below the Wolhuter and done. Out of the profit, £25,002 was paid as tax and £218,750 distributed as dividend, being at the rate of 17½%. The first distribution of profits was in 1912, when the dividend was 12½%. The ore development during the year was 603,700 tons averaging 53s. per ton. The amount of unprofitable rock developed was very small, and this fact together with the high content of the ore, forms an encouraging feature. The total reserve on December 31 was 2,167,653 tons averaging 42s. per ton, almost all of it being in the Main Reef Leader. A circular shaft, 18 ft. in diameter near the northern boundary and between the two hoisting shafts, is being sunk for the purpose of improving the ventilation. This shaft will be the upcast and the other two shafts downcast.



Plan of City Deep Workings.

New Goch, were acquired. It was not until the latter year that systematic development was commenced. A plant containing 200 stamps, including 8 Nissens, and 9 tube-mills has been erected, and started in 1910. Development has been conducted from two shafts, the Wolhuter, No. 1, and the City, No. 2, but there are not yet sufficient working faces to provide 65,000 tons per month and keep the plant at full capacity. The report for the year 1913 shows that the labour shortage interfered with mining. The tonnage hoisted was 530,503. After the rejection of 11·7% waste, 468,800 tons was sent to the mill averaging 38s. 5d. per ton, as compared with 479,630 tons averaging 35s. 9d. the year before. The yield by amalgamation was 131,787 oz. and by cyanide 78,734 oz., a total of 210,521 oz. worth £885,120 or 37s. 9d. per ton milled, as compared with £852,039 or 35s. 6d. per ton in 1912. The number of stamps at work was 150, over an average of 257 days. The cost was £599,447 or 25s. 7d. per ton, as compared with 23s. 9d. per ton, leaving a profit of £285,673 or 12s. 2d. per ton. The reason for the rise in cost was that no dump material was treated and that a greater amount of development was

New Goch.—This company was formed in 1887 as the George Goch to acquire claims on the outcrop in the central Rand between the Wolhuter and Nourse. There have been several reconstructions and rearrangements of property. Small dividends were paid in 1910 and 1911. The control is with the Albu group. The report for 1913 shows that 386,335 tons of ore was raised, and after the rejection of 15% waste, 328,350 tons averaging just under 5 dwt. was sent to the 120-stamp mill. The yield by amalgamation was 51,818 oz. and by cyanide 24,874 oz., a total of 76,692 oz., worth £324,533, being 4·68 dwt. or 19s. 10d. per ton milled. In addition 1012 oz. worth £4300 was recovered from accumulated slime. The working cost was £265,930, or 16s. 3d. per ton, and the working profit was £64,489 or 3s. 11d. per ton. Out of the profit £23,975 was appropriated for debenture redemption and £7476 was paid as interest on debentures. No dividend was distributed. The reserve was calculated on December 31 at 841,479 tons averaging 5·2 dwt., and the partly developed ore at 75,609 tons averaging 4·52 dwt. Later developments point to a resumption of dividends before long.

Robinson Gold.—The mine belonging to this company has been the most profitable on the Rand. It is now approaching exhaustion and practically the whole area has been developed. A few months ago a scheme for absorption by the Crown Mines was proposed, but as it was met by opposition in some quarters the directors are resigning and are asking for a vote on the resolution to re-elect them to be submitted at the meeting of shareholders to be held at the end of this month. The control is with the Rand Mines group. The report for the year 1913 shows that 700,149 tons of ore was raised and sent, together with 26,734 tons from the dumps, to the sorting station, where 8% waste was rejected. The mill treated 668,900 tons averaging 37s. per ton, for a yield of 201,609 oz. by amalgamation and 82,508 oz. by cyanide, a total of 284,117 oz., worth £1,195,913 or 35s. 9d. per ton. The working cost was £471,120 or 14s. 1d. per ton, leaving a profit of £724,792 or 21s. 8d per ton. The yield per ton was 7s. 11d. less than in 1912, and the cost 1s. 7d. lower. Out of the profit, £112,482 was paid to the government as tax and for undermining rights, and £412,500 was distributed as dividend, being at the rate of 15%. The reserve of ore on December 31 was estimated at 538,500 tons averaging 44s. 1d. per ton, together with 469,100 tons in shaft-pillars, etc. This ore is all in the Main Reef Leader and South Reef. It is estimated that there is also 772,900 tons in the Main Reef averaging 18s. 1d. per ton. Since the beginning of operations in 1888 the ore mined has totalled 7,897,416 tons, the gold recovered 4,399,254 oz., worth £18,496,273, and the dividends £9,987,187. The average yield has been 55s. 8d. per ton, starting at 243s. 4d. per ton in 1888 and gradually decreasing to 35s. 9d. in 1913. The company holds 40,000 shares in Crown Mines valued at £241,500 and has a cash reserve of £358,931.

Village Deep.—This company was formed in 1898 to acquire property on the dip of the Village Main Reef in the central part of the Rand. In 1908 claims still farther south were purchased from the Turf Mines company. The control is with the Rand Mines group, H. Stuart Martin is consulting engineer, and James Whitehouse manager. Dividends were first paid in 1908. There are three shafts, two of which are on the northern boundary that cut the ore at 2011 ft. and 2075 ft. respectively, and the other, the Turf shaft 3320 ft. to the south that cut the ore at 3815 ft. The present policy is to gradually reduce the amount of ore hoisted through the shallower shafts and to concentrate on the Turf shaft. A year ago the profits showed a great improvement, due to the policy of narrowing the stopes and raising the minimum gold content of the ore mined. The report for 1913 shows that owing to the serious decrease in the labour supply during the second half of the year, the output of ore, the yield of gold, and the profits have not been maintained. The ore mined was 606,232 tons which, together with 4688 tons from the dumps, was sent to the sorting station, where 12½% was removed as waste. The mill, containing 180 stamps and 6 tube-mills, treated 535,300 tons averaging 30s. 10d. per ton. The yield by amalgamation was 134,602 oz. and by cyanide 55,425 oz., a total of 190,027 oz., worth £798,687, or 29s. 10d. per ton milled. During 1912, 698,124 tons was hoisted, 596,900 tons milled, the yield being 212,109 oz. worth £889,246, and the average per ton the same as in 1913. The working cost was £551,578 or 20s. 7d. per ton, as compared with £594,436 or 19s. 11d. per ton, an increase of 8d. per ton. The working profit was £247,109, out of which £34,659 was spent on shaft-sinking and plant, £35,632 was paid as profits tax and rent, and £159,100 distributed as dividend, being at the rate of 15%, as compared with 17½% for 1912. Development was fully maintained, and 865,300 tons averaging 27s. 9d. was disclosed. The reserve on December 31 was estimated at 2,142,900 tons averaging 29s. per ton, together with 519,700 tons left in shaft and boundary pillars. About four-fifths of the reserve was in the Main Reef Leader and the remaining one-fifth in the South Reef.

Rose Deep.—This company belongs to the Rand Mines group and was formed in 1894 to acquire property on the dip of the New Primrose in the middle east Rand. In 1909 an amalgamation was effected with the adjoining Glen Deep owning the mine on the dip of the May and Glencairn. The consolidated company has a plant containing 300 stamps and 7 tube-mills. During 1910 much trouble was caused by caving in the upper levels. A year ago we recorded that all causes of anxiety had been removed and that conditions and prospects were excellent. The report now published, covering the year 1913, shows that a scarcity of native labour following the strike of July last had interfered with the amount of ore raised, and with the profits; moreover, the yield per ton was lower than in 1912. But on the other hand the cost had been reduced. During the year, 884,501 tons of ore was raised, and after the rejection of 13% waste, 76,807 tons averaging 27s. 3d. per ton was sent to the mills. The yield by amalgamation was 151,969 oz. and by cyanide 87,872 oz., a total of 239,841 oz. worth £1,007,353, being 26s. 3d. per ton. A year ago the tonnage milled was 782,200 tons, the yield £1,128,127, and the yield per ton 28s. 10d. The working cost was £637,689, or 16s. 7d. per ton, as compared with 17s. 5d. The working profit was £369,664, out of which £29,566 was paid as profits tax, and £297,500 was distributed as dividend, being at the rate of 42½%, as compared with 45% for 1912. The ore reserve on December 31 was calculated at 3,272,800 tons averaging 23s. 11d., not reckoning shaft-pillars and ore not yet fully developed. These figures are higher by 133,300 tons and lower by 15d. per ton as compared with those the year before. Additional slime plant has been erected, and the hoisting at No. 1 shaft is being changed to stage hoisting so as to avoid accidents at the bend in the shaft. A. J. Walton is the manager.

Geldenhuis Deep.—This company belongs to the Rand Mines group and was formed in 1893 to acquire property on the dip of the Geldenhuis in the eastern part of the central Rand. On the approaching exhaustion of the outcrop mine, the latter and the Jumpers Deep were absorbed in 1909. The plants owned by the consolidated company contain 420 stamps and 7 tube-mills, but only 300 stamps are in operation, as the Geldenhuis plant has been closed on the cessation of operations at that mine. For the last three years development has given disappointing results. The report for 1913 shows that 728,340 tons of ore was hoisted, and after the rejection of 14% waste, 623,450 tons averaging 30s. 7d. per ton was sent to the mill. The yield by amalgamation was 145,649 oz. and by cyanide 69,953 oz., a total of 215,602 oz. worth £906,800, or 29s. 1d. per ton milled. The working cost was £759,182 or 24s. 4d. per ton, leaving a profit of £147,618 or 4s. 9d. per ton. The yield per ton was 1s. 1d. less than in 1912 and the cost 1s. 6d. less. Out of the profit, £102,506 was distributed as dividend, being at the rate of 17½%. Owing to trouble with inrushes of water and rock in the shafts it has not been possible to open new levels, so that development has been restricted, only 282,370 tons having been disclosed. Moreover, in the western section much of the banket disclosed has been unprofitable. The reserve on December 31 was estimated at 1,669,500 tons averaging 26s. 11d. per ton, of which about half is immediately available for stoping. This reserve is about equally distributed between the Main Reef, Main Reef Leader, and South Reef.

Knight Central.—The property belonging to this company consists of a second deep below the Knights Deep and to the east of the Simmer East in the middle east Rand. The control is with the Neumann group, David Wilkinson is consulting engineer, and F. G. A. Roberts is manager. The company was formed in 1895, but milling did not commence until 1909. The only dividend was one of 5% in 1910. The property has been developed by two shafts. The great Simmer dike was encountered by both shafts in 1912 at depths of 3997 ft. and 4330 ft. respectively. This was proved to be 375 ft. thick and to displace the deposits by 620 ft. Full plans and sections were given in our issue of May 1913. The report for the year 1913 shows that cross-cuts have been driven through the dike on the 13th and 14th levels from the West shaft and on the 15th and 16th levels from the East shaft. The results of development of the deposits on the south side of the dike have been disappointing, but recently the prospects have improved on the 13th and 14th levels east and west. Two subsidiary inclines are being sunk, following the dip. During the year 305,954 tons of ore was raised, and, after the rejection of 6·6% waste, 278,010 tons averaging 5·59 dwt. was sent to the mill. The yield by amalgamation was 55,576 oz. and by cyanide 17,368 oz., a total of 74,944 oz. worth £314,279, being 22s. 7d. per ton. The working cost was £282,047 or 20s. 3d. per ton, leaving a working profit of £32,231 or 2s. 4d. per ton. The profit was more than absorbed by expenditure on shaft-sinking and new plant. The ore reserve on December 31 was estimated at 539,100 tons averaging 6 dwt., a fall of 107,900 tons during the year. This ore is all above the dike, as it has not yet been possible to block-out and fully sample the ore below.

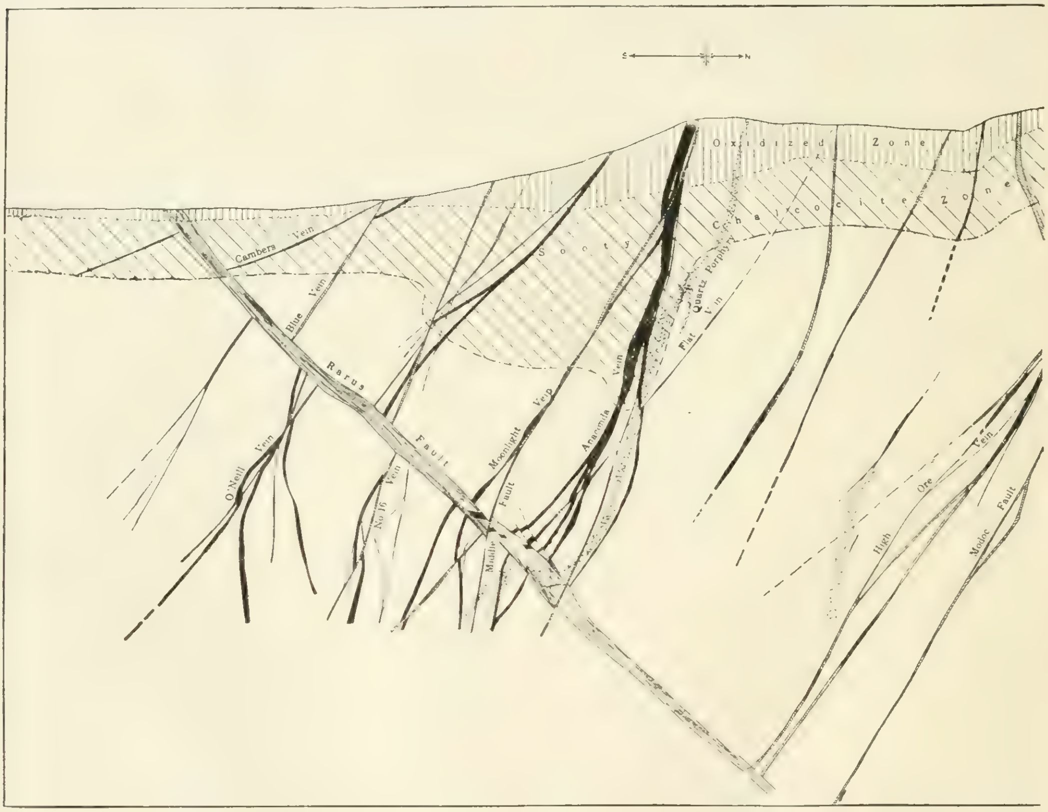
May Consolidated.—This company was originally formed in 1887 to acquire claims in the outcrop in the middle east Rand, and by reconstruction in 1889 and 1894 additional properties were acquired. Milling started in 1888 and the equipment was gradually extended until 100 stamps and cyanide plant were at work in 1896. The control is now with the Goerz group, W. M. Cameron is consulting engineer, and K. K. H. Sartorius is manager. The report for 1913 shows that the property is rapidly approaching exhaustion. The reserve on December 31 was estimated at 61,350 tons averaging 6·33 dwt., together with from 6000 to 8000 tons left in shaft pillars averaging 9·9 dwt. per ton. About 12,000 tons in shaft pillars are not expected to be recoverable. During the year the mill was fully supplied, but with poorer ore. The amount of ore raised was 197,211 tons, and after the rejection of 12½% waste, 171,610 tons averaging 4·9 dwt. was sent to the mill. The total yield of gold was 37,266 oz. worth £158,057, being 4·3 dwt. or 18s. 3d. per ton milled. The working cost was £118,739 or 13s. 9d. per ton, leaving a profit of £39,318, out of which £28,875 was paid as dividend, being at the rate of 10%. As regards the future, it is estimated that, with an adequate supply of labour, mining can be profitably continued until the latter part of the current year. Since the commencement of operations, the mine has yielded gold worth £4,840,928 and £1,500,156 has been distributed as dividends. Some of the cash in hand has been recently devoted to the purchase of shares in the Modderfontein Deep Levels, a company belonging also to the Goerz group, and developing property in the far east Rand. The money so invested amounts to £42,814, for which price 25,000 shares in the new venture were purchased.

Glencairn Main Reef.—This company was formed by the Barnato group in 1889 to acquire the western part of the property of the Witwatersrand Gold Mining Co. in the middle east Rand. Milling was started in 1890, and dividends were first paid in 1894. After the interruption of the war, dividends were not resumed until 1906, and since then the rates of distribution have been comparatively small. The report for 1913 shows that 273,328 tons of ore was raised which, together with 2202 tons from the dump, was sent to the sorting station, where 12·6% waste was removed. The 160-stamp mill treated 240,768 tons averaging 4 dwt. per ton, for a yield of 27,291 oz. by amalgamation and 14,969 oz. by cyanide, a total of 42,360 oz. worth £179,769, or 14s. 11d. per ton. The working cost was £156,810, leaving a profit of £22,959. In addition, a profit of £6376 was made by treatment of 23,831 tons of accumulated slime, from which gold worth £9946 was recovered. The shareholders received £27,500, being at the rate of 5%. The resources of the mine have been finally determined, as development has been completed. The reserve of ore is estimated at 191,257 milling tons. In addition, 793,326 tons is reported as of doubtful value, but half of it may be worth extraction. Some of the caved portions of the upper levels may also provide further supplies for the mill.

Rezende.—This company was originally formed in 1892 by the United Gold Fields of Manica, to acquire a gold-mining property near Umtali, Rhodesia, near the Portuguese border. Operations continuously gave disappointing results, and several reconstructions were necessary. In 1908 the control passed to the Anglo-French-Farrar group. In 1912 the adjoining property of the Penhalonga company was absorbed, which had for an equal length of time, under different control, been an unprofitable venture. After the amalgamation profits were made, the sum of £17,764 being distributed among shareholders during 1912. The Penhalonga mine is, however, practically exhausted. The office of the company has recently been transferred to that of Farrar Brothers. The report for the year 1913 shows that 161,789 tons was sent to the three mills, the amounts from each section being: Central 34,201, Old West Workings 41,490, Penhalonga 53,748, and dumps 32,350. The total yield by amalgamation and cyanide was worth £115,374 in gold and silver, while leady concentrate returned £28,384. An income of £2334 was made from royalty from tributers. The total profit at the mines was £32,456, and after the payment of London expenses and making allowance for depreciation, the net profit was £28,784. The sum of £17,765 was distributed as dividend, being at the rate of 15%. S. R. Jameson, the manager, reports the reserve at 90,491 tons averaging 8·2 dwt. per ton in the Central section, and 183,121 tons averaging 3 dwt. in the Old West Workings. At the latter section the conditions are such that low-grade material can be mined and treated at a profit. In addition, 50,000 tons of uncertain value is on the dumps in the Penhalonga section. During the year, the arrangement by which the Old West Workings were let to tributers was terminated, and the property is now being extensively developed by the company. The prospects here and in the Central section are promising. Arrangements are being made for the increase in the power supply, and the capacity of the hydro-electric station at Odzani is to be increased by 400 horsepower.

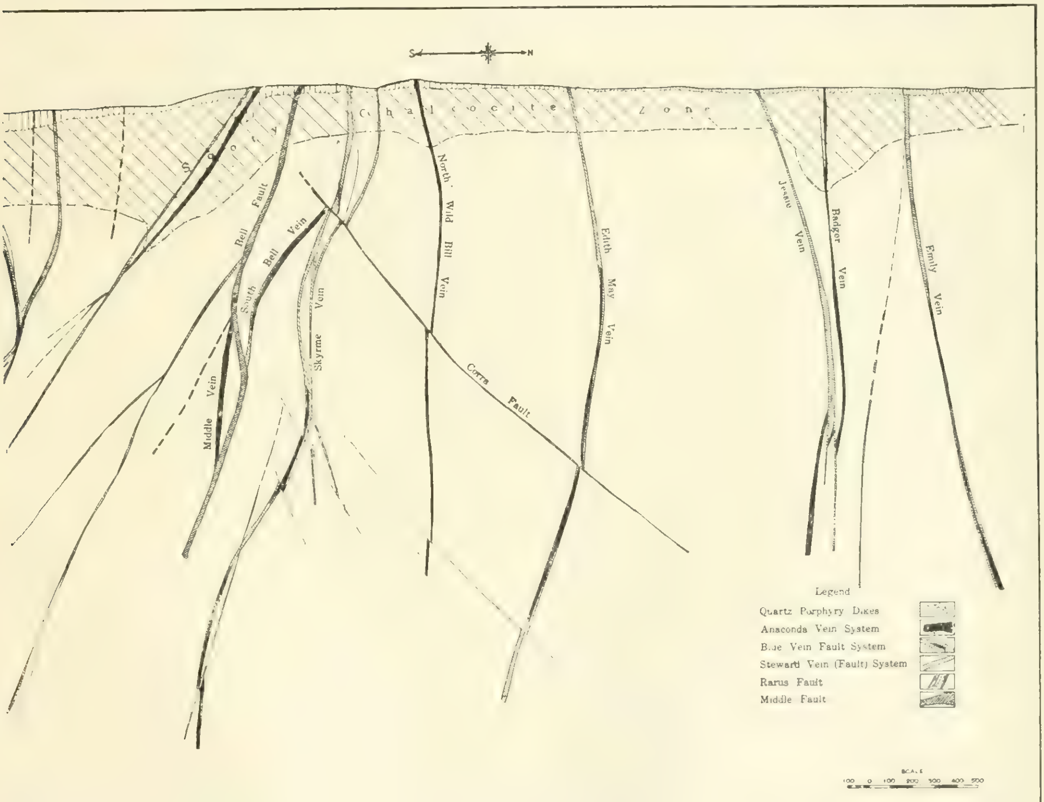
Anaconda Copper.—The report of this copper-producing company with mines at Butte, Montana, for the year 1913 shows that severe weather in January and February restricted the shipments of ore, and that the smelter was closed for 11 days in October for flue-cleaning and repairs. An unusual amount of low-grade ore from development was sent to the smelters. The result was that a smaller amount of ore was treated and the average extraction of metals declined slightly as compared with 1912. The ore raised from all the mines totalled 4,644,201 tons, and 7243 tons of precipitate was produced, making a total of 4,651,444 tons. Of this, 4,566,450 tons was sent to the Anaconda and Great Falls smelters, together with 619,864 tons of purchased and custom ore. The amount treated at Anaconda was 4,016,689 tons and at Great Falls 1,170,150 tons. The yield of metal from the company's material was 241,983,323 lb. copper, 8,719,132 oz. silver, and 64,898 oz. gold. The accounts show sales of metal $44,003,473, and value of metals still on hand $16,173,788 against $14,895,383 brought forward from the previous year, $18,457,558 mining expenses, $8,709,580 reduction expenses, and net profit $11,283,226. The dividends distributed during the year absorbed $12,997,500, being 12% on the issued capital. The developments gave gratifying results in almost all the sections. The High Ore shaft is being sunk to 3400 ft., the deepest in the district, and in the Original mine at 3000 ft., the next deepest, an important discovery of ore was made. Progress has been made with slime concentration, the system of superposed round tables being adopted. The capacity of the plant is 2000 tons per day, and it should be ready before long.

Esperanza.—This company was formed in 1903 to acquire the majority of the shares of the Esperanza Mining Co., a New Jersey corporation operating the Esperanza gold mine at El Oro, Mexico. After paying handsome dividends for some years, the approaching exhaustion of the deposit was indicated three years ago and the profits have been greatly reduced. The report for 1913 shows that 85,722 dry metric tons of ore was raised and treated, of which 52,803 tons came from the 9th level, and in addition 121,438 tons of old tailing from the dumps was re-treated. The value of the bullion produced was $1,459,764, and the profit was $421,806. The amount distributed was $247,800, of which £42,966 was paid as dividend in England, at the rate of 10%. The reports by Charles Hoyle, the manager, and H. A. Titcomb and R. M. Geppert, the consulting engineers, show that the reserve on January 1 was estimated at 113,500 tons, which should yield a profit at the mine of $423,000. In addition, 85,000 tons are returned as possible ore, and the retreatment of old tailing is expected to give a profit of $240,000. The developments on the San Carlos lode have defined the limits of the profitable portion, but drilling is to be conducted at or near points where the lode passes into the lower andesites. Development at depth on the San Rafael lode has given negative results, though in some of the upper levels further amounts of ore have been disclosed.



VERTICAL SECTION SHOWING

British Broken Hill.—This company was formed in 1887 to purchase Blocks 15 and 16 from the Broken Hill Proprietary. The purchase price was £675,000 in cash and £400,000 in shares. The capital was £1,200,000 in shares of £5 each. The mine has been one of the least successful in the district, as the total dividends have been only 30% on the original capital. In 1890 additional capital was raised by the issue of 60,000 privileged shares of £2 each ranking equally for dividends with the £5 shares. In 1895 the capital was reduced to £264,000, by the lowering of the par value of the ordinary shares from £5 to £1 and of the privileged shares from £2 to 8s. In July 1912, 60,000 new shares nominally worth £1 were issued at 50s., to provide funds for the development of a new orebody discovered at depth in the neighbourhood of Thompson's shaft near the centre of the property. On two occasions work has been suspended during periods of low prices for the metals. After the last stoppage, work was resumed in 1910. An Elmore vacuum plant was erected for the treatment of the zinc tailing, but was dismantled shortly afterward, and the tailing sent to the Zinc Corporation for treatment. The concentration plant has recently been entirely remodelled. Additional tables have been provided in the lead plant, and also Lyster machines for removing galena from the slime. A Minerals Separation plant was put into commission on December 5 last, but has not yet been completed in all details. The report for the half-year ended December 31 last shows that 109,284 tons averaging 12·8% lead, 11·9% zinc, and 7·3 oz. silver per ton was sent to the lead mill, where 14,926 tons of lead concentrate was produced averaging 61·6% lead, 7·3% zinc, and 24 oz. silver per ton. During the few weeks the Minerals Separation plant was in operation before the termination of the half-year, 7845 tons of tailing was treated averaging 12·7% zinc, 3·9% lead, and 4·2 oz. silver, for a yield of 1375 tons of zinc concentrate averaging 40·7% zinc, 12·2% lead, and 12 oz. silver. The zinc tailing despatched to the Zinc Corporation was 70,745 tons, and 7297 tons of slime was delivered for the Junction North company. The consulting engineer, George C. Klug, and the manager, C. J. Emery, gave details of the development of the new orebody. Plans accompanying the report show that this body is deep and wide and of comparatively small length on each level. Consequently the full extent and average content is not easily demonstrated. The bore-holes gave varying results and show the average grade of the ore to be mined to be comparatively low. The reserve is estimated at 1,014,300 tons averaging 13% lead, 10·9% zinc, and 6·5 oz. silver per ton. The accounts for the half-year show an income of £167,462 from the sale of products and a net profit of £46,478, out of which £45,000 has been distributed as dividend, being at the rate of 1s. per share.



VEIN SYSTEM AT ANACONDA.

Amalgamated Zinc (De Bavay's).—This company operates the De Bavay flotation process at Broken Hill, and treats the zinc tailing produced at the North, South, and Block 10 mines. It also holds shares in the Minerals Separation & De Bavay's Processes Australia Proprietary company, which pools the royalties accruing from these two processes in Australia. W. L. Baillieu is chairman, and H. W. Gepp is manager. The report for the half-year ended December 31 last shows that 253,225 tons of zinc tailing was treated, for a production of 73,947 tons of zinc concentrate averaging 49·2% zinc, 6% lead, and 8·9 oz. silver, and 804 tons of lead concentrate averaging 52·2% lead, 18·6% zinc, and 35·3 oz. silver. Owing to the fall in the price of zinc, the basis price for the calculation of receipts and profits has been reduced from £22 to £21. The profit was £67,029, and £62,500 was distributed as dividend, being 2s. 6d. per £1 share.

Waihi Grand Junction.—This company was formed in 1895 to acquire gold-mining properties adjoining the Waihi mine in the northern island of New Zealand. Milling started in 1906 with 40 stamps. There are also ten tube-mills. Additional plant, consisting of 60 heavy stamps, was ordered and delivered, but not erected. The early history of the company was by no means satisfactory, and it was not until 1910, when the present manager, W. F. Grace, assumed control, that development and mining work was made adequate to the promise of the mine and the capacity of the mill. Dividends of 5% were paid in 1910 and 1911, but nothing was paid for 1912, owing to the suspension of work following the general strike of miners throughout New Zealand. The report for the year 1913 shows that operations were not properly reorganized after the strike until February. The number of men available at that time was only one-fourth of the complement required, and the collection of further men has been a slow process, owing to so many miners having left for other centres in Australia and elsewhere. Machine-drilling has been substituted for hand-drilling so as to economize labour, and other labour-saving devices have been introduced. The supply of men is still short. During the year, 98,383 tons of ore was raised and treated for a return of bullion worth £184,888, being an extraction of 41s. 7d. per ton, of which gold represented 36s. 5d. and silver 5s. 2d. The net profit was £41,590, out of which £38,437 was paid as dividend, being at the rate of 10%. The development being hindered by lack of labour, the ore reserve fell from 187,750 tons to 175,100 tons. The work done on No. 6 level of the Empire lode and foot-wall leader gave excellent results. On the other hand, the Royal lode proved to be broken and of low content. Shaft-sinking was continued and the No. 1 or Main shaft is now at a depth of 1212 ft. No. 7 level has been commenced at 1200 ft. Mr. Grace has erected 20 of the 60 heavy stamps that have been at the mine for some years, partly to allow of repairs to the present mill, and partly in the expectation that with increased supplies of labour it will be possible to mine more ore and to expand the reserves.

Mountain Queen. — This company was formed in 1910 to acquire, from the Lake View & Oroya Exploration Co., a gold mining property 19 miles south of Southern Cross, in the Yilgarn district of West Australia. In August 1912, the Transvaal mine in the same district was purchased. James Brothers are the consulting engineers, Bewick, Moreing & Co. are the general managers and F. L. Thomas is superintendent. The venture has been a disappointing one so far. The Transvaal mine has not responded to development, and the sulphide ore at the Mountain Queen is of low grade and refractory. The report for the year 1913 shows that the oxidized ore at the Mountain Queen is practically exhausted, though a small extension of surface-deposit was found. The mill has been occupied in treating the ore from this extension and in re-treating accumulated slime. The ore milled was 43,283 tons, from which 10,794 oz. gold was recovered, being 21s. 2d. per ton; and 22,618 tons of accumulated slime gave 2368 oz. The revenue was £56,456, and the profit £11,841, out of which £7132 was spent on the Transvaal mine, and the remainder written off the general expenditure account. The policy with regard to the sulphide ore has not been settled. In our issue of November 1912, we gave an account of the mill erected at the Mountain Queen, which consists of two Holman air-cushion stamps. The record of this mill for 1913 shows that its average duty was 69·64 tons per 24 hours, or about 35 tons per stamp.

Leeuwpoort (African Farms) Tin Mines.—This company was formed under Transvaal laws in April 1912 for the purpose of acquiring tin deposits near Potgietersrust in the Waterberg district of the Transvaal, not far from the Zaaiplaats and Rooiberg mines. The control is with the Witwatersrand Township, Estate, and Finance Corporation, of which Julius Jeppe and Sir Abe Bailey are directors. S. C. Thomson is consulting engineer, and J. Irvine Jameson is manager. The capital is £275,000 in shares of £1 each, of which 162,500 were subscribed in cash. The report now published covers the year 1913, and shows that milling commenced at the beginning of October, and that during the three months to the end of the year, 9827 short tons of ore was stamped and dressed for a yield of 110 long tons of concentrate. The assay-value of the ore treated was 1·82% metallic tin, and that of the concentrate 64%. The mill contains 2 Nissen stamps weighing 1500 lb., 15 ordinary stamps weighing 1250 lb., tube-mill, Huntington mill, jigs, Buss tables, Wilfley tables, Isbell vanners, round frames, rag frames, Richards-Janney classifier, Dorr thickener, and Brunton furnace. For the first two months, during the starting of the plant, it was purposely arranged that the ore fed to the mill should be below the average grade. The ore reserve on December 31 was estimated at 124,392 short tons averaging 2·2% metallic tin, as compared with 110,519 tons averaging 2·26% the year before. The workings are scattered, there being 6 main hoisting shafts ranging from 219 ft. to 652 ft. in depth on the incline. At the New Strike area, many veins have been proved, though they are difficult to follow owing to the disturbed ground; prospecting and development work is being actively continued. The characteristics of the ore at the different workings vary considerably, as the size of the cassiterite grains ranges from coarse to the finest, while in depth much pyrite makes its appearance. The question of treatment therefore demands continuous attention. The accounts show an income of £16,450 from the sale of concentrate, and working cost amounting to £13,510. During the year 7690 ft. of development was done including 632 ft. of shaft-sinking.

Tingha Consolidated Tin Mines.—This company was formed in Melbourne in the year 1906 to acquire tin-gravel properties at Tingha, New South Wales. James Symes is manager. The report for the half-year ended January 31 shows that operations have been restricted by drought, and that the fall in the price of tin has diminished the income. The output of tin concentrate was 44 tons, as compared with 71 tons during the preceding half-year, and the income from sales was £5140 as compared with £9427. The total cost was £6008, leaving a loss of £868. Owing to scarcity of water, only two of the four pump-dredges were at work regularly. During the period an option was taken on a neighbouring property, and tests have been made by boring. As these gave promising results, the ground is being tried by one of the pump-dredges.